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THE FOREIGN OUTLOOK.

There has been some falling off during the past year in the value of exported manufactures, although it may be doubted whether the quantities are any smaller. The chief reasons to explain the slight decline are the troubles in the Far East, the serious depression in Germany and the burdens of war that hamper England and are ruining South Africa. We are glad to note, however, that the branches in which our readers are more especially interested, hold their own, as will already have appeared from our weekly export summaries. For the ten months to the end of October, this year shows a total of $4,916,656 for electrical machinery, as compared with $4,555,015 in the same period of 1900. In the class of "electrical and scientific apparatus," the total is also $5,582,445 as compared with $5,401,365. Metal working machinery exports are, we regret to note, only $2,373,740, or less than half as much, and miscellaneous machinery is only $15,367,281, or nearly five millions less. Limitation of purchasing ability may explain much of this, but it is evident that the trade already started must be and can be extended by intelligent persistence, a wider area of sales offsetting a smaller margin of profit. The world at large has need of such goods in increasing volume and will buy in the best market.

THE TELEPHONE AND TELEGRAPH.

We have often speculated on the possibilities of rapid communication as compared with the facilities which are actually available. Great as have been the improvements in both telegraphic and telephonic methods, there is still a field for usefulness that is even now practically unoccupied. This is to be found in union of rapid telegraphy with the telephone as a distributing agent. We have on the one hand several beautiful methods of very rapid telegraphy capable of greatly increasing the capacity of every existing wire as a means of communication, and, on the other hand, a considerable network of long-distance telephone lines, beautifully proportioned for rapid work, and unutilized during a material part of every day. One of the chief objections raised against rapid machine telegraphy is the difficulty of providing adequate facilities for handling promptly the volume of business piled upon the receiving offices, and the serious dislocation of affairs in case of a temporary hitch in the transmission of messages. In long-distance telephony the main practical hindrance to efficiency is the trouble in getting hold of the man at the other end of the line. Every one who has ever had occasion to use long-distance lines knows how busy they are during a considerable part of the day, and the irritating delays that come through no fault of the telephone company, but merely because so many persons are anxious to talk at once.

During the night, however, long-distance conversation is far from active for obvious reasons, especially after 10 or 11 o'clock, and the costly lines are earning far less than is desirable on the score of general economy. A line does not deteriorate from use, and the larger proportion of the time it can be kept busy the greater its net earning capacity. Now, let us see what would be the result of forming a joint committee, as it were, of these two methods of transmitting intelligence. Suppose, for instance, that during the four hours from 1 to 5 A. M. a single line between Chicago and New York were worked up to its full capacity by modern machine telephony. Assuming the use of an automatic printing instrument at a working speed of a hundred words a minute or thereabouts, 500 ten-word messages per

hour in each direction would be within the range of capacity of the system if such messages were directed to the respective telephone numbers of the recipients. These message slips could simply be filed away and telephoned to the proper addresses on the opening of business hours, the slips being mailed as an additional check, as fast as telephoned. Meanwhile, during the day and evening such registered messages would be taken from telephone subscribers on a typewriter and passed along to be perforated or otherwise prepared for rapid transmission during the night. The result would be a very convenient and cheap method of sending messages which would be delivered in the course of a few hours, and a considerable increase in the earning capacity of every long telephone line. Something in the way of delivering telephone messages is now often done, but we know of no comprehensive and cheap scheme for extending such a service by rapid telegraphy.

One conspicuous advantage of such a process is the benefit put at the disposal of telephone subscribers by affording them a very cheap and convenient means of sending night messages. It would probably effect this result without at all injuring the regular long-distance telephone business, which is peculiarly a hasty service utilized to economize time to the utmost. It would rather occupy a special place by itself, giving a very useful and economical service for many purposes, and giving the telephone subscriber remarkable advantages in general means of communication. Whether it would in the long run pay to extend such a service to the delivery of messages to non-subscribers, in other words, to a general telegraph business, is a matter worthy of further consideration, but this is in nowise directly involved in the proposition here advanced. One convenient feature of the matter is the ease with which the plan could be tried and worked out into the best commercial form, and the facility with which the service could be extended in case its reception by the public warranted such a step. Every year the long-distance telephone service becomes more and more important to its patrons, and if hand in hand with its extension went what would be in substance a cheap night telegraph service, both the public and the telephone companies would be the gainers. We have not here broached any of the more revolutionary proposals involving the use in every case of wires for simultaneous telegraphy and telephony, nor have we opened the general question of an open competition between the two great methods of transmitting intelligence. There certainly is a considerable opportunity for such radical moves, but without any introduction of dubious methods or policies there is here a capital opportunity for opening a new source of revenue and doing the public a favor that would still further increase the popularity of the telephone. It is an experiment which could be gone into in the most tentative way and worked out to its legitimate conclusion without any great expenditure or radical change in existing relations. In the form indicated or in some manner closely allied thereto, it is certainly worthy of a serious trial even if only on a single long-distance line.

TELEPHONY IN AMERICA.

Our current issue presents an interesting picture of the general telephonic situation in this country. On every hand the greatest activity prevails. Old exchanges are being remodeled and renovated. Large new exchanges are everywhere under construction, or contemplated; and the flow of new capital into the field is enormous. It seems likely that such development must continue for some time to come, the average facilities for the country, as a whole, being far below the percentage of equipment to population that prevails not merely in regions where the "independents" have been most energetic but in some Bell territory, where competition has hardly been felt.

It will be noted that much, if not nearly all, of the new exchange work is being done along the lines of the "central energy," "common battery" system, which can hardly any longer be regarded as being on trial, although we know some managers who do not look upon it as the final expression of the art. In the meantime, automatic exchange telephony is occupying attention, and our present issue contains articles on two efforts in this interesting field. Whither they will lead we cannot say, but every one will admit that the attempt to work automatically is an effort in the right direction. It is many years, however, since we first recorded inventions along this line.

The industrial activity in telephony is attested not only by the introduction of new methods and improved apparatus but by the formation of new local companies and their rapid growth, as shown very strikingly by the copious notes in our department of telephone news. Many of these companies are small, and many are trying to give good service at rates far below those which can long ensure efficiency and solvency; but all are helping to put the telephone in its right place as a universal and indispensable means of intercommunication.

DELEGATES TO THE A.I.E.E. ANNUAL CONVENTION.

While the next annual convention of the American Institute of Electrical Engineers, is yet a long way off, it is nevertheless not too early for bodies of the membership to begin to take under consideration the formation of State and district organizations as provided for by the new constitution, which bodies shall be entitled to send a delegate to the annual convention. This feature of the new constitution is a most commendable one, and particularly so because its realization will not only give a more national character to the general meeting, but will also enable distant bodies of the membership to have a greater voice in the management of the Institute than it has been possible for them to have in the past. The provision referred to forms Article IX. of the new constitution, and specifies that in each State or Territory of the United States in which there are 50 or more members and associates, an organization may be formed which shall have the privilege of being represented at the annual convention by one delegate to each 50 members. Upon application to the secretary a list of names will be forwarded of the membership in the given State, and upon organization the secretary is required to prepare and distribute the necessary circulars for the nomination of a delegate. The constitution directs that the appointment of the delegate thus nominated shall then be made by the board of directors, which shall also name an alternate delegate—presumably also to be nominated by the State membership. The delegate thus appointed is entitled to receive from the treasury of the Institute a sum of money sufficient to cover the cost of his railroad fare, and he may cast as many votes as he shall hold proxies from his constituents upon any question brought before the annual convention.

From the above statement it will be seen that the initiative toward the formation of State organizations lies with the individual members, which implies that to take advantage of the provision some one or more members in each locality will have to take the lead. In several localities outside of New York City there are already more than the necessary 50 members, and in quite a number of others the shortage is so small that if a few of the resident members were to enlist their services in the cause, the list could easily be expanded to the required quota of 50. Should this, however, be impossible, the same Article provides that the members and associates of a State or Territory not having a sufficient number of members may, upon the request to the board of directors, be authorized to join with the members and associates of a contiguous State or States and form a district, which for the purposes of the Article shall be considered as be-

ing one State, but shall be called a district, and shall take its name from the State therein having the largest membership.

It is quite probable that within the next few months a programme for raising an Institute building fund will be brought to a successful issue, in which case the next annual convention would be one of unusual interest and importance. As a consequence it appears extremely desirable that the membership in different States of the Union should take advantage of the provision of the new constitution referred to, and organize in order that they may have a delegate present to take part in the settlement of important questions that may come before that meeting. The choice of a delegate will confer no small honor on the recipient, and incidentally the names thus brought forward will materially assist the membership as a whole and the Board of Directors with respect to determining upon nominations for vice-president, which nominations by the new constitution are required to be made with a view to maintaining a geographcal distribution of the incumbents of that office.

THE DISTRIBUTION OF ELECTRICAL ENERGY IN CITIES.

The batch of papers read before the November meeting of the American Institute of Electrical Engineers and abstracted in our issue of last week, are of particular interest as revealing the trend of thought and opinion in regard to the relative advantage of direct and alternating-current apparatus. It is now conceded as a matter practically beyond dispute, that alternators must be installed in the central generating stations of large cities owing to the distances between a satisfactory power house site and the center of electrical distribution, as well as on account of the necessarily large radius of transmission. In small cities it is conceded that alternators are preferable to direct-current generators at the central station, owing to the scattered nature of the lighting service, and to the high pressure that must be used to reach the scattered lighting economically. In fact, it is now generally admitted that practically the only cases where direct-current lighting generators are preferable to alternators are those of isolated plants, or small densely lighted areas with good local facilities for the supply of fuel—conditions which suggest magnified isolated lighting plants.

Granting that alternators must be selected for central station generation, the question arises as to how much of the system should be kept alternating, and where does it pay to convert from alternating to direct current? Manifestly, if the regulation of pressure could be kept equally good in either system, and if the various translating devices, lamps and motors could be made equally cheap and serviceable for either system, then the selection of an alternating-current generator for the supply of electric power to the system would necessarily entail the use of alternating currents from one end of the system to the other. The trend of present opinion is, however, that while alternating currents are specially advantageous for the generation and transmission of electric power, and are superior in these respects to direct currents, the regulation and delivery of power are better secured by direct currents.

In regard to regulation, the drop of pressure with load is greater in the alternating-current system than in the direct-current system, by reason of the additional inductive drop which the direct-current system does not know. Consequently, in low-pressure distribution the conductor has to be made larger if alternating currents are used. Moreover, in large low-pressure networks the storage battery is the great modern equalizer and safeguard against sudden break-down; it is the flywheel of the whole system, regulating the pressure automatically, and preserving the service in cases of sudden brief breakdown of the steam plant in a central station. For this reason alone the direct-current distribution system has been greatly preferred to the alternating by the engineers of large low-pressure distributions.

With regard to translating devices, the arc lamp will operate equally well on either the direct current or the alternating-current distribution system, if the latter has the usual frequency of 60 cycles per second. The incandescent lamp will also operate equally well on either system if the frequency of the alternating system is over 30 cycles per second. With motors, however, the case is different. The synchronous alternating-current motor is superior to the direct-current motor in regard to the maintenance of constant speed, but, of course, is far inferior in regard to starting power. The modern alternating-current induction motor starts satisfactorily, except from the standpoint of starting-current flow, and gives satisfactory service at constant full speed. It is also superior to the direct-current motor in point of construction, being devoid of commutator and much less likely to burn out. On the other hand, it is not on a parity with the direct-current motor in the capability of regulating its speed under load, and at present it is considerably more expensive in this country than the direct-current motor. In large cities a considerable amount of the demand for power comes for elevators and hoisting machinery generally. In this class of machinery it is necessary to regulate the speed, and the comparison is very much in favor of the direct-current motor for such purposes.

It seems safe to say that if elevator motors could be operated by alternating currents as cheaply and effectively as by direct currents, a number of cities would be likely to operate their entire system by alternating currents, in spite of the less perfect security and regulation, in the absence of storage battery reserve. Since about one-third of the output of a large central generating system is for the supply of motors, of which elevator motors form, or tend to form, a considerable fraction, the importance of the alternating-current motor problem is readily observed. It is really the keynote to the whole situation. Partly owing to the simpler system of distributing mains in the direct-curent system, partly owing to the advantage of storage battery regulation, and largely owing to the commercial inferiority of the alternating-current elevator motor in comparison with its direct-current prototype, engineers go to the trouble, complication and expense of installing rotating machinery, i. e., converters, in numerous sub-stations, in order to supply direct currents to the distributing network of mains.

We may, therefore, look forward with hope to such improvements in the manufacture of the alternating-current motor as will reduce its first cost, and increase its torque under variable speed, without unduly increasing the current it absorbs. The direct-current motor has probably more closely approached its limitations in regard to cost and serviceability than has the alternating-current motor. If the alternating current motor can be so far cheapened and improved as to place it on terms of equality with its direct-current rival, we may expect to see the direct-current distribution system, with its converter sub-stations, slowly give place to the alternating-current distribution system with no mechanical moving parts between the geenrator at the central station and the motor on the consumer's premises.

Summing up the matter, we may say that at the present time the generation and transmission of electrical energy on a large scale belong to the field of alternating currents, while the distribution of electrical energy on a large scale from a system of city mains still belongs to direct currents. And that in the transmission of electrical energy by polyphase alternating currents the four-wire three-phase system seems to have distinct advantages in mixed lighting and power systems over the three-wire, three-phase system.

Right to Erect Telephone Lines in New York State.

The question was brought before Judge Chester, of the New York Supreme Court, recently, of the right of the Monticello Telephone Company to erect telephone lines in that place. It will be seen that while denying a writ of mandamus, the Judge reflected upon the behavior of the board of trustees in not exercising the functions for which it was created. He said: "The company asks for a peremptory writ requiring the defendant to grant to it a permit to erect poles, string its wires and conduct its business in the village of Monticello according to the terms of its written application presented to the board of trustees of such village. The laws defining the rights of telephone companies and the powers of the boards of trustees of villages seem reasonably clear. The transportation corporations law (Laws 1890, Chapter 566, Section 102) gives to telephone companies the right to erect, construct and maintain the necessary fixtures for their lines upon any of the public roads, streets and highways within the State. And this has been held to be a franchise directly from the Legislature to the corporation to use the public streets for constructing and maintaining its lines. Barhite v. Telephone Company, 50 App. Div. 25, 63 N. Y. Supp. 659. But, notwithstanding this, the village law (Laws 1897, Chapter 414, Section 89, Subdivision 9) confers upon boards of trustees of villages power 'to regulate the erection of telegraph, telephone or electric poles, or the stringing of wires in, over or upon any of the streets or public grounds.' This is a power involving discretion upon the part of the board of trustees, and the exercise of this discretion cannot be controlled by mandamus. While the courts can compel the exercise of the power, the particular method of its exercise cannot be controlled by mandamus. People v. Commissioners, 149 N. Y. 26, 43 N. E. 418. Manifestly neither the court nor the board of trustees of the village has any right to grant the request of this company to string its wires upon poles belonging to other companies, as appears by the application filed by the company with the board of trustees it has requested the privilege of doing. It appears very clearly here by the papers used on this application that the board of trustees have sought to either prohibit entirely or to embarrass the telephone company very materially in its rights to use the streets for the purposes of its company, and have delayed passing any regulations for that purpose a long time. It was not unreasonable, however, for the trustees to require the filing with them of a map by the telephone company showing where it desired to locate its lines and poles before passing an ordinance regulating their erection.

Electrical Engineers of the Day—XXIII.

PHILIP G. GOSSLER.

Mr. Philip Green Gossler is one of the youngest of the many young men filling positions of great responsibility in the electrical field, having been born in August, 1870, at Columbia, Lancaster County, Pa. Nevertheless, he has had up to the present time eleven years of active professional experience of the most varied character.

Mr. Gossler was graduated as mechanical and electrical engineer from the Pennsylvania State College in 1890, when he was not quite 20 years of age. During a portion of the following year he was engaged in mechanical and electrical engineering work, respectively, with the Chester Foundry & Machine Company, at Chester, Pa., and with the Edison General Electric Company at New York City.

In April, 1891, he began the work in which he has since then been continuously occupied—the practical electrical and mechanical engineering and operation of generating and distributing plants for electric lighting and power service. At that time he joined the staff of the United Electric Light & Power Company, of New York City. He remained with that company until he went to Montreal in May, 1895, to accept a position with the Royal Electric Company, of which company he is now general superintendent and electrical engineer. His duties have greatly enlarged and increased with the growth and development of the business of the Royal Company, and have included every form of engineering appertaining to steam plant, hydraulic or water power plant, high-voltage long-distance transmission, as well as local distribution.

When he entered the service of the United Electric Light & Power Company, of New York City, the business of that company consisted of the operation of the arc-lighting plant and system of the United States Illuminating Company, and the arc-lighting plant and system of the Brush Electric Illuminating Company, to which had but recently been added incandescent lighting by alternating current. Besides generating stations established especially for the latter service, several of the stations of the two companies were remodeled and reconstructed to provide in addition to their original service, a system of alternating-current incandescent lighting service.

At just about that time also was begun the distribution of current for arc and incandescent lighting by cables in underground conduits. Mr. Gossler was engaged in the most intimate and practical way in all the work attendant upon such remodeling and reconstruction, in new installations for new class of service, and in the selection, testing and placing of underground cables, then a new art. Amid all this varied practical work he did not overlook or avoid original investigation and work of precision for commercial purposes. In 1892 he conducted a series of most complete tests of incandescent lamps, the results of which were published in these columns in the issue of Sept. 17, 1892, and which, at the time, had a particular value in that they furnished valuable data from a source independent of the lamp manufacturer, and which were determined especially for the central station man.

With such a diversified experience in New York City during more than four years, he was in a special manner equipped to undertake the necessary remodeling, reconstruction and extension of the generating and distribution plant of the Royal Electric Company at Montreal. Some of the first and immediate results of that work

were embodied in a paper prepared for and read at the 1897 convention of the Canadian Electrical Association, and subsequently published in pamphlet form which received a widely extended circulation by reason of its appreciation by central station managers.

He has been closely associated with the installation and operation of the 20,000-hp water power electric generating plant on the Richelieu River, and the high-voltage 18-mile transmission line of the Chambly Manufacturing Company (now the Montreal & St. Lawrence Light & Power Company). The construction of the transmission line was done under his immediate supervision, and is notable as an example of best methods, and has a record of entire immunity from lightning damage during the four years it has been in position.

The administration of the business of the Royal Electric Company, the Imperial Electric Company, the Montreal & St. Lawrence Light & Power Company, and the Montreal Gas Company has recently been taken over by the Montreal Light, Heat & Power Company, all to be operated by the latter company as one organization. The scope and extent of the work under the charge of Mr. Gossler will thereby be greatly increased. By reason of his experience, ability and characteristic energy, it is easy to anticipate that he will fulfill the requirements of his increased responsibilities with the same satisfactory result and enlargement of his capabilities that have hitherto attended his efforts.

Mr. Gossler is a member of the American Institute of Electrical Engineers, and has been elected president for the current year of the Canadian Electrical Association.

The Telephone Exchange System of the Maryland Telephone and Telegraph Company.

By KEMPSTER B. MILLER.

THE telephone system of the Maryland Telephone & Telegraph Company, with headquarters at Baltimore, furnishes one of the most striking examples of the progress of independent telephony in this country, that I know of. A description of the personnel of this company, the system it has installed, and the work that it has accomplished, should, therefore, be of general interest to the telephone public. This company owns and controls plants in Baltimore, Catonsville, Pikesville and Roland Park in Baltimore County; Ellicott City, in Howard County, Maryland; Belair, Aberdeen, Churchville and Havre de Grace in Harford County; Wilmington, Delaware, and in many other smaller places. The personnel of the company is as follows: President, George R. Webb; vice-president and general manager, David E. Evans; chief engineer, Sidney Hand Browne. Mr. Webb has been the active spirit in the movement to give Baltimore a cheaper and better telephone service than that accorded by the Potomac Telephone Company, a local Bell licensee. He is as well president of the Pittsburg & Allegheny Telephone Company, whose headquarters are in Pittsburg, the system for which was described in an article by me in ELECTRICAL WORLD AND ENGINEER of Nov. 2, 1900. Mr. Webb is also president of the entire system of electric railways and electric light companies in Baltimore. Mr. Evans is well known to the electrical public, having conducted, before retiring, an extensive contracting business, making the construction of electric roads a specialty. To him the Maryland Telephone & Telegraph Company owes a great deal for his able management. Mr. Browne, the chief engineer, is responsible for the character of the large plants of both Baltimore and Pittsburg, and for the great rapidity with which they have been developed. Under his able guidance plants have been constructed within the past two years, for the same people who are interested in the Baltimore and Pittsburg plants, having an aggregate of over 17,000 telephones in actual service, and several hundred miles of toll lines. By these toll lines connections are afforded with something over 96,000 telephones belonging to other companies, and with which companies traffic agreements have been formed as to exchange of service.

In Baltimore the municipal subway system is used, for which an annual rental of 5 cents a duct foot is paid. The general system of distribution is entirely underground in a large part of the city. About 200,000 ft. of underground cable is installed, of which about 75 per cent of the total length is 200-pair cable. All cable is made up of No. 20 B. & S. copper wire, with two wraps of paper and sheath made up of pure lead without tin. It tests 300 megohms per mile, and shows an electro-static capacity of .085 m. f. per mile. This was manufactured by the Standard Underground Cable Company, of Pittsburg. About 100,000 ft. of aerial cable has also been erected, the sizes being from 25 to 150 pairs, the greater portion being 100 pair. The lead sheath of this is 3-32 inch thick, or thicker.

The general style of construction is modern, and, unlike many other independent companies, the plans of the Maryland Telephone & Telegraph Company have been liberal and broad, and the growth, which they have been able to handle easily, has been remarkable. When it is considered that the first service in the city exchange was given Jan. 1, 1901, and that there is now a total of considerably over 6000 lines actually working within the city limits, one of the best arguments of the popularity of independent telephony in general, and of this company in particular, is afforded. Less than two years ago there were not more than 2000 telephones in Baltimore; to-day there are 11,000, of which the Bell Company has about 5000. As an indication of the present rate of growth of the exchange, it is stated that, during the month of October, 575 new telephones were installed in Baltimore, and that the outlook indicates a still greater number for November. The management report that the company is in a most flourishing condition financially, and making good money, which, after all, is the ultimate measure of success in any business enterprise.

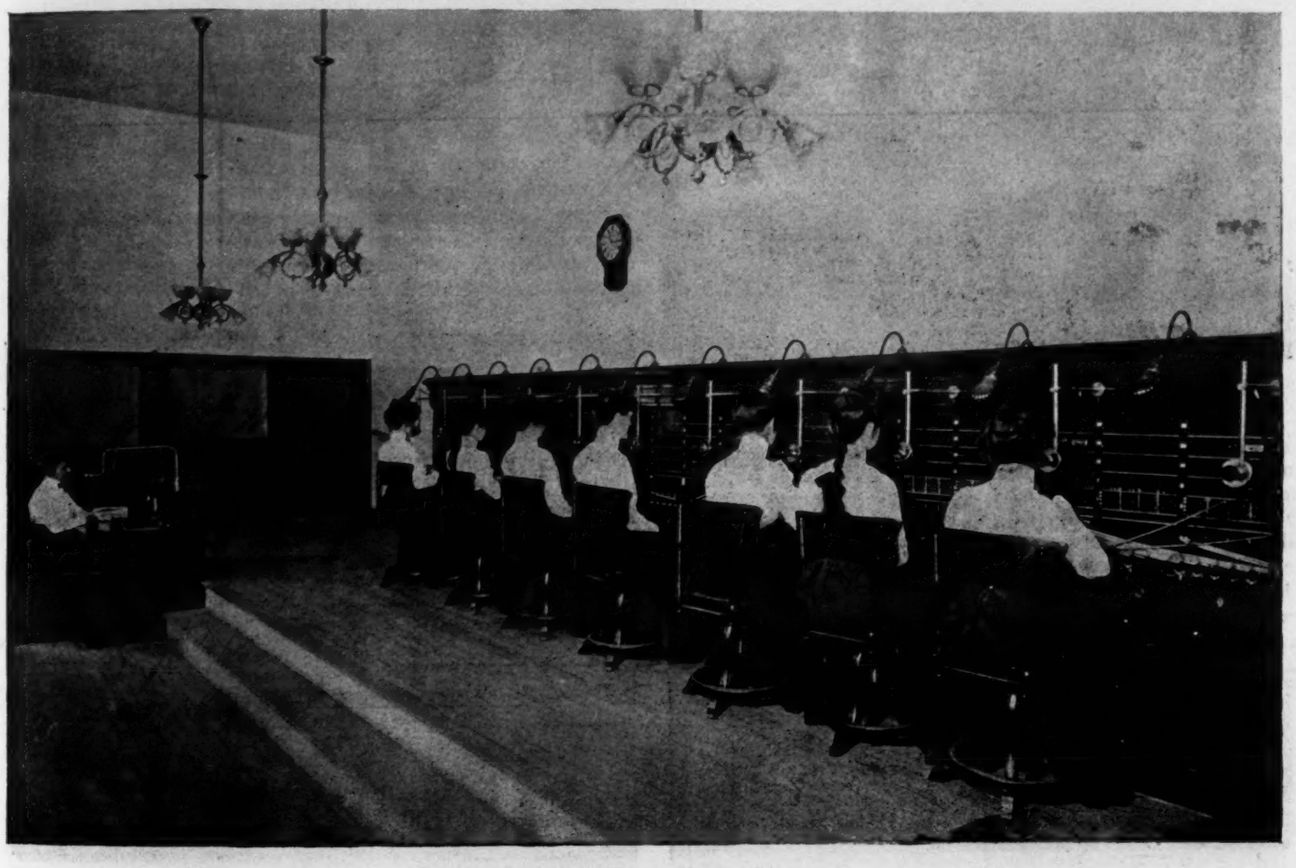

FIG. 1.—OPERATING ROOM, DRUID EXCHANGE.

There are four exchanges belonging to this company in the city of Baltimore, as per table on next page.

The main or Courtland Street exchange is located at the corner of Lexington and Courtland streets, just across from the Courthouse. The switchboard, and all central office apparatus for this ex-

change, and, in fact, for all of them, was furnished by the Kellogg Switchboard & Suply Company, of Chicago. The switchboard

Name.	Ultimate capacity.	Present lines in service.
Courtland	6,000	4,100
Druid	3,000	960
Henrietta	1,000	510
Windsor	1,000	490
	11,000	6,060

consists of 19 sections, of which 17 are for local and outgoing trunk work, and two for incoming trunk work. The sections are of angle

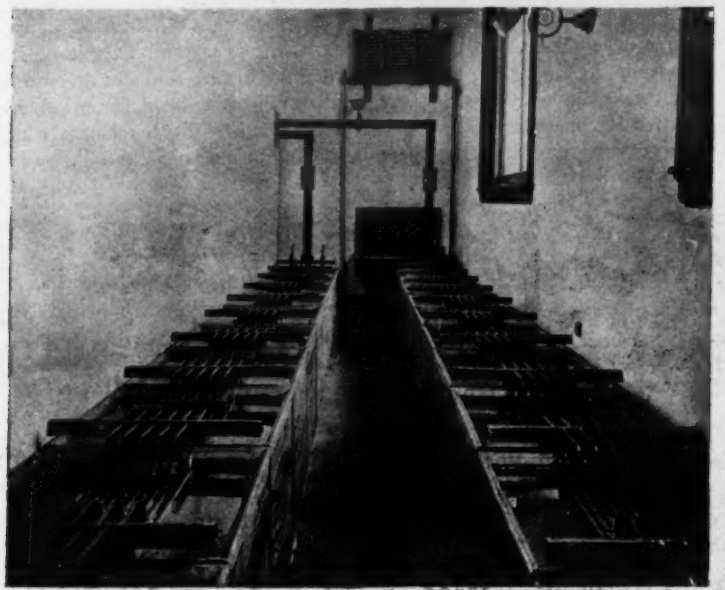

FIG. 2.—BATTERY ROOM, COURTLAND EXCHANGE.

iron construction, the weight of all the apparatus and cabling being borne by the iron structure, independent of the woodwork. This iron framework rests on the true floor. A false floor, or platform 17 inches high, is placed in front of the switchboard, against which false floor the woodwork of the switchboard finishes. The exposed portions of the woodwork is mahogany, rubbed to a dull finish, while the unexposed portions, such as cord racks, are of oak. The sections are completely closed at the rear by removable wooden

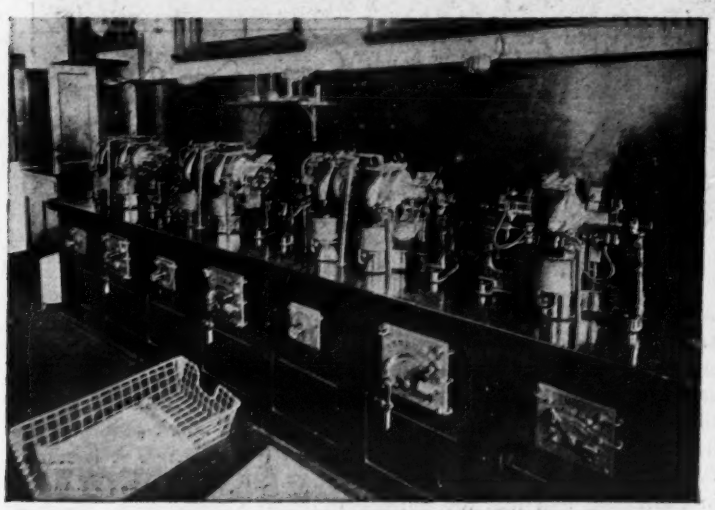

FIG. 3.—CHARGING AND RINGING MACHINES, COURTLAND EXCHANGE.

panels which, when taken out, expose the cabling and all other parts to view.

The connecting rack for each section, and the running box for the cables leading to the connecting rack, and also the line and supervisory relays, are carried on the rear of the switchboard framework. The supervisory relays are of dust proof pattern, and are not enclosed, while the line relays are enclosed in dust proof boxes, containing the entire group of each section. A view of the main operating room, showing this switchboard, is given in Fig. 5. The layout of this room, and the supporting columns in its center, make it almost impossible to do this board justice in the photograph, because both ends of the board are necessarily cut off, and some of the intermediate portions are obscured.

Each of the 17 local sections is provided with a capacity of 300 answering jacks and line signals, and a present equipment of 260. Each of the incoming trunk sections is equipped with 120 incoming trunk lines, 40 to each position. Each of the 19 sections is also provided with 4060 multiple jacks, and with an ultimate capacity for 6000. The incoming trunk lines terminate in cords, according to the latest practice. All of the local cord circuits are provided with a double supervisory system, by the means of which a supervisory lamp is placed under the control of each subscriber connected. That is, when a connection is made between two subscribers, each of the two lamps belonging to the pair of cords is under the control of the subscriber to which that cord is connected.

There are three keyboards, and three operators' positions to each section, the jack frame being divided into six panels. The key shelves are made of five-ply mahogany, while the plug shelves, which are also of mahogany, are provided with a layer of heavy belt leather, which takes the wear off the plugs dropping into their seats. The vacant spaces on the face of the board are filled with ebony panels, which harmonize in color with the hard rubber faces of the jacks. The finishing stile strips are of brass, finished in black oxide, and carry the designating numbers of the jacks. The arrangement for lighting the face of the board is clearly shown in this picture.

The manager's and chief operator's desks are located in the center of the exchange, as shown. The current for the talking apparatus, and for all signaling purposes, with the exception of ringing the subscribers, is furnished by two storage batteries consisting of 10 cells each, of Chloride accumulators, the elements having 11 plates each and are contained in lead-lined tanks. The current is taken from

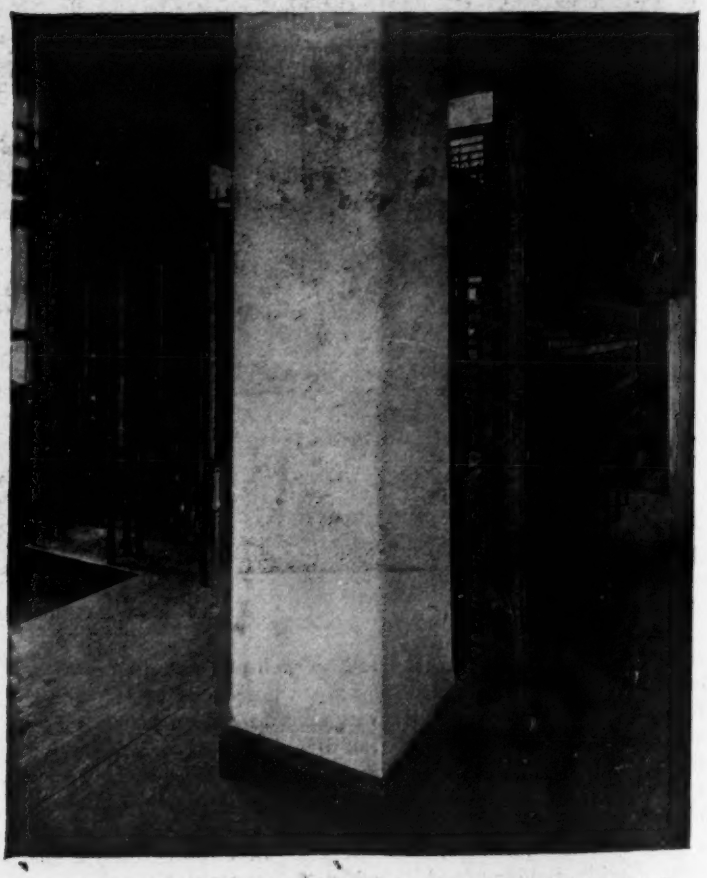

FIG. 4.—TERMINAL AND DISTRIBUTING ROOM, COURTLAND EXCHANGE.

these batteries by copper bars, having a cross section 3 inches by ½ inch. The battery room of this exchange is shown in Fig. 2, two of the bus-bars leading from the batteries being shown in the far end of the room.

The power equipment of this exchange is shown in Fig. 6. On the right may be seen the charging and ringing machines, which are shown more clearly in Fig. 3. These machines are five in number,

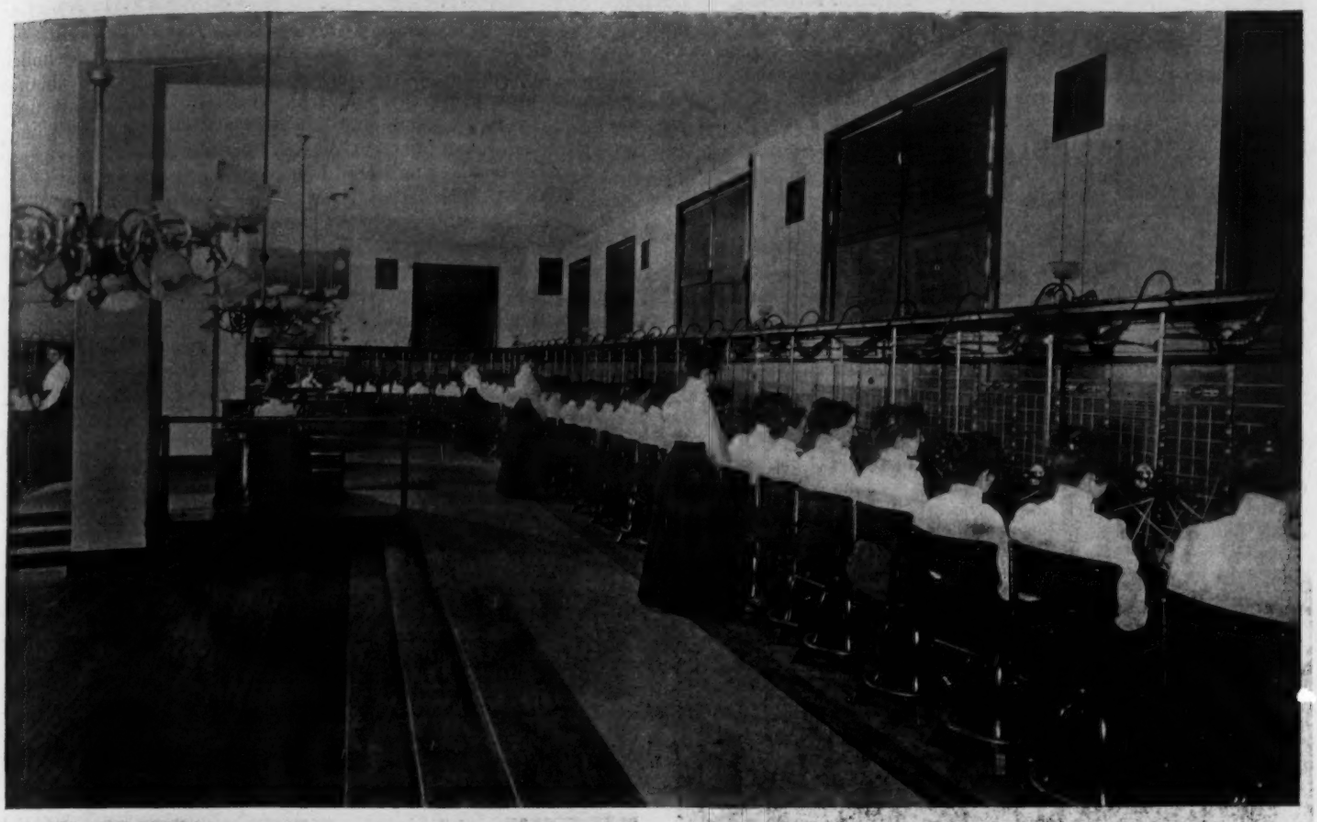

FIG. 5.—OPERATING ROOM, COURTLAND EXCHANGE.

FIG. 6.—POWER EQUIPMENT, COURTLAND EXCHANGE.

all of Crocker-Wheeler make. Two of these are motor-generators for ringing, having primaries wound for 220 volts direct, and secondaries giving alternating current for actuating polarized bells. The other three are motor-generators for charging the batteries, having primaries wound for 220 volts direct, and secondaries having sufficient voltage for charging 10 storage cells in series. All of these machines are mounted on a handsome power table, under which is carried a full equipment of starting boxes, field rheostats, etc. On the left of Fig. 6 is shown the fuse board and the power switchboard. The fuse board is of marble, and contains fuses for all leads to the cord circuits. The power switchboard is of Italian marble, and has mounted upon it Weston volt and ammeters, and suitable ammeter and voltmeter switches, two I. T. E. circuit breakers, and a full complement of all copper double-throw double-pole switches for handling the various charging and discharging leads.

The wire chief's and trouble clerk's desks are shown in the foreground of this picture, while a distant view is obtained of the cable terminal rack, and the main distributing board. A clearer and better view of the terminal and distributing room is shown in Fig. 4. At the left of this view is shown the cable heads, which are of the Cook pattern, manufactured by the Sterling Electric Company.

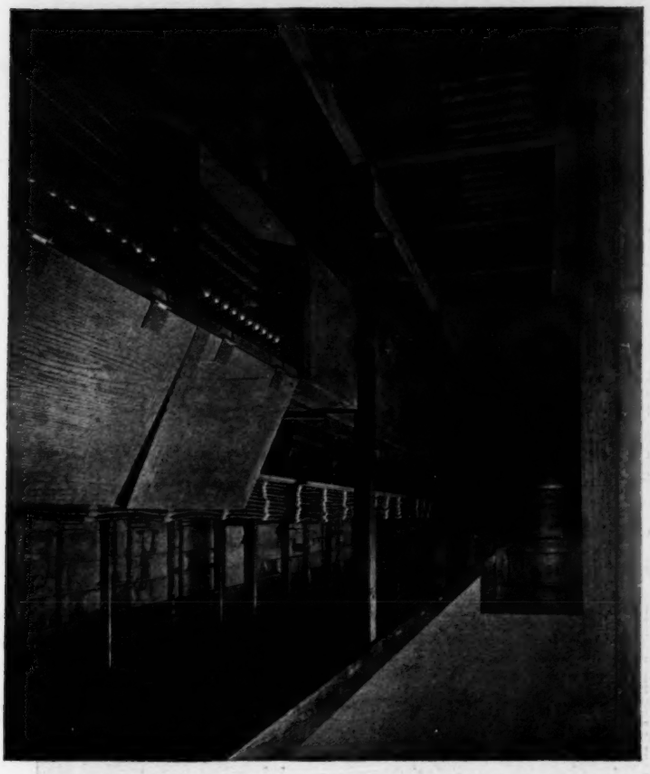

FIG. 7.—REAR VIEW OF SWITCHBOARD, DRUID EXCHANGE.

These are mounted on an iron rack, and the line or shaft cables leading from the subways may be seen entering at the bottom of these heads. These heads are provided with heat coils, and carbon static arresters. The cables leading to the main distributing boards emerge from the top of the cable heads, and are lead in channels furnished in the angle iron structure, to the line side of this distributing board, shown on the right of this picture. From the switchboard side of this distributing board other cables lead, as may be seen in the upper right-hand portion of the picture. These go downward, as shown in the foreground, and pass into the running boxes leading along the back of the sections, as already referred to.

The plan of wiring is as follows: Beginning at the cable heads, from which point the Kellogg Switchboard & Supply Company carried the complete installation, the lines are carried in 21 pair cables to the distributing board. These are made fast to the line terminals on the distributing board. This applies to subscribers' lines, and incoming and outgoing trunk lines, order wires and desk lines. From the distributing board, all subscribers' lines are carried in 21 pair cables to the connecting racks on the subscribers' sections, from which the lines continue to the relays and answering jacks on the local sections. From the first trunk section, the lines are multipled through each of the other sections in 21 pair cables. In a similar manner, the incoming trunk lines are wired from the distributing board to incoming trunk sections. The switchboard cable used throughout is of No. 24 B. & S. tinned copper wire, provided with a wrapping of silk and of cotton, afterwards covered with heavy paper and a cotton braid. The whole is immersed in beeswax, and afterwards polished. The battery leads and power wires are of Okonite, and of suitable carrying capacity throughout. The same applies to the electric light wiring for illuminating the front and rear of the sections. All power wiring is carried in the roof of the sections.

The Druid, Windsor and Henrietta exchanges were also furnished by the Kellogg Switchboard & Supply Company, and as they do not differ materially from each other, only one of them will be described.

Fig. 1 shows a general view of the Druid exchange, which consists of four sections of six-panel switchboard, three of them being for local and outgoing trunk work, and one for incoming trunk work. The three local sections are provided with 40 outgoing trunk lines multipled in every section, 240 answering jacks and signals, and with 720 multiple jacks extending throughout all four sections. The incoming trunk section is equipped with 60 incoming trunk lines, terminating in cords and plugs. The rear of the switchboard is shown in Fig. 7, the closing panels being removed. Several of the floor panels are also taken up, showing the cable run underneath. In the foreground at the right-hand portion of this picture, two of the relay boxes are open, showing the supervisory relays in the upper portion of the boxes, and the line relays below.

The power equipment of this exchange is shown in Fig. 8. The machines for charging and ringing are seven in number, two being 1-hp Wagner alternating-current motors, 60 cycles, 104 volts, so arranged as to drive three ½-hp Roth generators, designed to charge 10

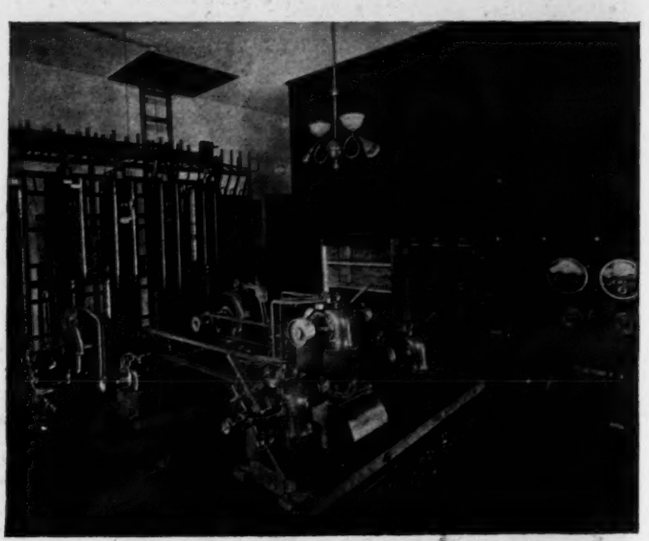

FIG. 8.—POWER EQUIPMENT, DRUID EXCHANGE.

storage cells in series. Besides the above, there are two Roth 1-6-hp ringing machines for furnishing the ringing current. These machines also are adapted to be run by the Wagner motors. The power switchboard and fuse board in this exchange are of slate, provided with Jewell instruments, I. T. E. circuit breakers and suitable switches. Cook terminal heads are used, as in all of the other exchanges. Two storage batteries supply the current for talking and signaling, these being Chloride accumulators, in lead-lined tanks.

The Baltimore & Maryland Telephone Company erected their own buildings for all of the four exchanges, the type of the building erected for the branch exchanges being shown in Fig. 9, which represents the Druid Exchange building, located at the corner of Druid Hill Avenue and Roberts Street. These buildings are well constructed, and arranged particularly for the purpose for which they were built.

Besides the equipment for the four exchanges there are three suburban exchanges, which were also equipped by the Kellogg Switchboard & Supply Company, these being at Catonsville, Roland Park, and Pikesville, and provided with trunk lines for incoming and outgoing trunk work, with all the city exchanges. These, like the city exchanges, are arranged on a common battery plan.

Fifteen positions of the switchboards in the city exchanges are equipped for party-line ringing. Two, four and six-party line rates are being given, which are proving popular, particularly in residence districts. The company has obtained the contract for the entire service of the city departments. No free telephones are given to the city, as the city exacts a pole tax of $2 per year. A private exchange furnished by the Kellogg Switchboard & Supply Company, with a capacity of 300 lines, has been installed by the Maryland Telephone & Telegraph Company, in the City Hall, to which are now connected over 100 telephones and 40 desk sets. The city purchased the switchboard and telephones, and in addition pays an annual rental for the

FIG. 9.—DRUID EXCHANGE BUILDING.

trunk line service and maintenance, amounting to approximately $5,000 per annum.

The toll lines to Western Maryland and Southern Pennsylvania and Delaware towns, include Frederick, Md.; Wilmington, Del.; Westminster, Md.; York, Pa.; Delta, Pa.; Ellicott City, Mr.; Port Deposit, Md., and a large number of other points, so that this company now covers practically the entire territory between Washington, D. C., and Philadelphia.

I am indebted to Mr. S. H. Browne, the chief engineer of the company, for much of the information contained in this article.

The St. Louis Exposition.

Mr. Henry Rustin, electrical engineer of the Louisiana Puchase Exposition Company, under the direction of Director of Works Isaac S. Taylor, began his duties Nov. 26. Mr. Taylor has already invited bids on the work, and it is understood that two firms, either of which is prepared to provide a plant of the dimensions required, have made propositions as to time and price.

The plant will have to provide illumination and power for the intramural railway, for the operation of exhibit machines, and for pumps for cascades, fire protection and water supply, and will be one of the largest in the world. It will have a capacity of about 15,000 kilowatts. This is more power than is used by the Laclede, Missouri-Edison, Imperial and the Transit companies combined. Bids will be received both for individual units of 1000 kilowatts and for the entire plant. The present intention is to put the big power plant as an exhibit in the center of the machinery building. It will be operated there under as attractive conditions as if it were in one corner of the grounds shut off from public view. The boiler plant will have to be kept separate from the main exhibit, both because of the danger of fire and because of the heat.

There is under consideration the firing of the boiler plant by oil from Texas instead of with coal. To supply access for fuel, the boiler house will have to be built near a railway terminal and the oil shipped in tank cars.

Recent Common Battery Telephone Exchange Work in New York City.

BY HERBERT LAWS WEBB.

THE New York Telephone Company has lately transferred the service of its Cortlandt Street district to the new common battery exchange, thus completing the conversion begun just three years ago with the opening of the first common battery exchange at Harlem, of the entire Manhattan system to common battery working. The housing of the new exchange has involved the building of an annex to the Cortlandt Street building on its eastern side, three floors of which, each 44 ft. by 22 ft., are occupied by cables, distributing frames, power plant, wire chief's desk and other auxiliary apparatus, and the construction of a new top floor over the old building. The Cortlandt Street telephone building was put up in 1888, and was designed for eight stories only, so that the addition of a new floor to carry a telephone switchboard and its personnel involved considerable structural alteration to the building. The additions to the building and the new exchange were the subject of an interesting illustrated article in ELECTRICAL WORLD AND ENGINEER of Nov. 9, 1901., but there remain a number of technical points to which attention may fitly be drawn at the present time, now that the exchange has gone into full operation.

The new operating room occupies the entire new ninth floor, which is 67½ ft. wide at the base of the U and 120 ft. long in each limb. Each limb or wing of the room is 20 ft. wide, with windows on each side, affording abundance of light, and the two are joined by a bridge at the back of the building. Connection is had with the operators' quarters, which occupy the entire ninth floor of the Dey Street building, by a doorway in the end of the west wing of the operating room, and the bridge affords a short cut to the east wing. The new switchboard consists practically of two entirely separate switchboards, one made up of 30 subscriber sections and the other of 18 trunk sections. This is the modern way of building large switchboards, as the equip-

FIG. 1.—PRIVATE BRANCH EXCHANGE SWITCHBOARD.

ment of subscribers' sections is so different from that of incoming trunk sections that it is no longer the comparatively simple matter it once was to convert the one into the other, and it has been found more satisfactory to separate the two portions of the board, giving each the space to grow in its own way.

The floor plan of the new ninth floor of Cortlandt Street has lent itself to a very effective treatment of the two switchboards, which has been taken advantage of by the New York Telephone Company's engineers and by the Western Electric Company—constructors of the entire plant—in such a manner as to produce a result that is a positively artistic piece of workmanship. On the ninth floor of the annex is the intermediate distributing board, which is necessarily cabled direct to the switchboard. The doorway connecting the annex floor with the operating room is about 30 ft. from the front of the building, therefore this point forms an admirable situation for a cable-turning section from which both switchboards shall spring. The cables are brought out in iron frameworks in the upper part of the doorway and then divide and bend downward into the switchboards in a bold double curve, a very Niagara of insulated wire, but all as

orderly, as solid and as even as the most exacting eye could require. The cable-turning section forms a sort of triumphal arch with a doorway through the center. From its southern end springs the subscribers' board, 30 sections, building from left to right, going first south, then west, then north, the thirtieth section being at the end of the west wing, while from the northern end springs the incoming trunk board, 18 sections, building from right to left, and occupying the remainder of the east wing. A great advantage of this arrangement is that each portion of the board is brought close to the intermediate distributing board, from which all the switchboard cable necessarily springs. The multiple cables go right and left to the multiple jacks in either part of the board; the answering jack cables go to the right directly to the subscribers' sections, as do the outgoing trunk cables, while the incoming trunk cables go to the left to the incoming trunk board. The other various cables, relay, repeating-coil and lamp leads also diverge and go direct to their respective apparatus. In weight, an important item in dealing with the masses of cable used, and in accessibility, the novel arrangement of switchboard and cable-turning section has effected considerable gains.

The new switchboard offers many points of interest, and even a cursory inspection shows how great has been the progress in telephone engineering during the past few years, while the contrast between the new board and the old—the greatest thing of its kind when it was built—is as great as between the latest mile-a-minute automobile and the steam carriage of our ancestors. The gain in compactness is a striking feature. The new switchboard occupies practically the same space as the old, but it contains 50 per cent more jacks per section in a slightly smaller section. The old board contained 44 sections of 6000 jacks each; the new board contains 48 sections of 9000 jacks each. This gain in compactness has been made by employing a small jack; but the employment of a small jack, or rather the placing of so large a board in the space formerly occupied by one of much more limited capacity, has been made possible by the relay system of working. The operation of a connection is now so largely automatic that an operator can handle more calls in a day than formerly, and consequently more answering jacks can be placed in a section, this naturally being the measure of the space a board must occupy. In the new board 320 answering jacks per section are provided, there being three operators' positions at each section.

Another interesting feature of the board that strikingly illustrates the rapid development of the telephone service which set in a few years ago and still continues is that it is equipped for its full capacity from the very beginning. Formerly it was the custom to build a switchboard framework for a much larger number of multiple jacks than it was originally equipped with, the idea being to provide for a relatively slow growth by leaving space for the addition of multiple jacks in the dim future; the original equipment was said to be so many lines, and the "ultimate capacity" so many more. Often, however, this "ultimate capacity" could never be utilized, since it was impossible to find space for the additional answering jacks and keyboard equipment required. The new board is equipped practically for its full capacity from the beginning, and it will be noticed in the pictures of the board that there is no array of spare panels between the multiple jacks and the top of the framework. In a picture of the old Cortlandt Street board illustrating an article in the *Electrical Engineer* for Oct. 15, 1890, the spare panels occupy as much space as the multiple jacks actually equipped. Under present conditions, when the monthly net increase of subscribers is enough to fill up a moderate sized exchange, it is not worth while to put in even a large switchboard only partially equipped, as this would mean additional work and disturbance within a short time, so the full capacity is installed from the beginning.

The relay system of working has often been described, and the general method of handling connections was touched on in the account of the cut-over of the exchange in ELECTRICAL WORLD AND ENGINEER for Nov. 9 last. A number of refinements have been introduced in the Cortlandt Street board, and at the moment it represents the latest stage in the development of the common battery system, and in switchboard design generally. The outgoing trunk jacks are placed immediately above the answering jacks and are all clearly designated by conspicuous labels. A very large proportion of the work of any city exchange being trunked out, it is important to have the trunk jacks easily available and distinguishable, and to do everything possible to accelerate the rapidity of trunk working. The call-wire circuits come to a compact battery of buttons placed at the left of each operator's position. Certain of these call wires lead to toll points, and on pressing one of these buttons a red pilot lamp lights in front of the operator as a reminder that the pressing of that button involves the making of a toll check. At each position there is still another pilot lamp, the lighting of which signifies that the exchange manager wishes to speak to the operator. On receiving this signal the operator presses a call wire button which connects her to the manager's circuit, and that functionary can then speak to all the operators at once, as if he had them gathered in a hall and was speaking from a platform. The object of this arrangement is to trace quickly the cause of faulty connections, cut-offs and so on, and to give general instructions regarding the service. Of course, with the relay system of working, cut-offs are not expected to occur, but neither operators nor subscribers are yet quite automatic, and among 400,000 connections a day, one or two errors from one cause or another are very apt to slip in. These devices show how many ingenious wrinkles the common battery can be called upon to take care of in addition to the general "load" of the exchange.

A notable difference in the general appearance of the exchange is caused by the use of breastplate transmitters instead of the old swinging switchboard transmitters. This is one of the very few items of telephone equipment that America has adopted from Europe. The breastplate transmitter has been in use in several European countries for a number of years, and the advantages of doing away with the suspended instrument hanging in front of the board and of having the transmitter follow the operator in all her movements are so great that, once adopted, the breastplate instrument becomes standard equipment. Beyond the restraint of a conservatism that at first blush seems at variance with the well-known rapid development of telephonic apparatus, but has its solid reasons in the enormous cost of rash experiments in complicated systems, American engineers were not eager to take up the breastplate transmitter because of the well recognized fact that the standard of telephonic transmission generally is lower in Europe than in this country. It was held that the breastplate transmitter would not give as good results in transmission as the standard switchboard solid back, and its adoption was never pressed. The mechanical part of the European breastplate transmitter, also, was not up to American standards. A special design of transmitter has been evolved here, however, which proves thoroughly satisfactory both electrically and mechanically, and now nobody concerned would go back to the old swinging transmitter.

The breasplate transmitter was first tried at the incoming trunk sections of the old Cortlandt Street board, and although the operators at first did not like them, this prejudice quickly disappeared, and after a short experience nothing would have induced them to give them up. Now they are standard equipment, and not only do they greatly improve the appearance of the board by doing away with the swinging instruments and their cords and brackets, leaving the face of the board entirely free, but they add to the comfort of the operator and leave her hands freer for the natural work of manipulating keys and cords. Another advantage of the breastplate transmitter is that it enables each operator to have her individual telephone set complete, an altogether desirable arrangement. By plugging into special jacks fitted in the face of the keyboard the operator connects her transmitter and receiver to the switchboard when she comes on duty, and when she goes off she unplugs and puts the apparatus away in her locker. Since one improvement naturally leads to another, the transmitter and receiver jacks are fitted in duplicate at each position and every supervisor is provided with a transmitter and receiver. A supervisor can, therefore, in a moment plug in at any position where a momentary rush of work is on and temporarily become an overflow operator, fully equipped to aid the regular operator who is overtaxed for the time being. Since there are supervisors, in proportion of one to every 10 or 12 positions, constantly patrolling the board, the little five-minute rushes that occur every now and then in the telephone traffic of a big city are thoroughly well taken care of. Without the breastplate transmitter, it is not such a simple matter for a supervisor quickly and effectively to share the work of a "position."

The subscriber positions are equipped with the regulation combined listening and ringing keys, arranged for selective signaling on party lines. A mechanical signal shows by the display of a small target which station the operator has rung, so that in case it is necessary to ring more than once the operator does not have to rely on her memory as to which station to ring, and runs no risk of ringing up the wrong one.

The incoming trunk sections are two-position sections, and are

designed for the operation of 30 incoming trunk lines per position. The operating of incoming trunks has undergone one refinement after another ever since the adoption of the call-wire double-track method of working. Practically, the only part of the work that is not automatic is the speaking of the orders over the call wire, the assignment of the trunk and the selection of the multiple jack by the receiving operator. This being done, the receiving operator puts the plug into the jack and presses an automatic ringing key which causes periodic trills to be given on the subscriber's bell until he takes down the receiver. That causes the button of the automatic ringing key to resume its normal position. Should the subscriber fail to answer after a liberal period of trills, the trunk operator restores the automatic ringing key by releasing a catch and puts the trunk plug into a signal jack, which results in the lamp on the connecting cord at the subscriber operator's position in the originating exchange winking the notification: "Don't answer." Similarly, if the trunk operator finds that the line wanted is busy she puts the trunk into a signal jack that causes the originating operator's lamp to wink "Busy." When the connection follows its normal course, the subscriber-operator gets the disconnection signals, and as soon as she disconnects from the trunk a disconnection signal lights in front of the incoming trunk cord, whereon the trunk operator promptly disconnects. As during the busy periods of the day there is a mass

FIG. 2.—MONITOR SWITCHBOARD.

of cords up on the incoming trunk sections, and often the plug is a long way off from the cord shelf, the cords are colored red, white and blue, alternately, to minimize the risk of the wrong plug being pulled out when neighboring operators are helping each other. With cords all the same color it is comparatively easy for an operator to mistake the cord to be disconnected, when, as often happens in busy times, it is one of a mass of cords lying under and over each other. Such mistakes lead to cut-offs and are to be avoided by every possible means, as a cut-off is about the most exasperating of telephonic errors. With the colored cords it is easy to trace accurately the particular cords to be disconnected.

The casual visitor to a telephone exchange takes it quite as a matter of course that electric lamps should occupy the place of annunciators for signals, and that magneto generators and batteries should disappear from the subscribers' stations. How it is all done, like all the other mysteries of electricity, is quite beyond him, and to attempt to explain the battery of machinery that lies behind the relay switchboard would be waste of effort on the part of his guide. It is in the department given up to terminals and power plant that the development of telephone engineering becomes really impressive. Not much over ten years ago the terminal room of a telephone exchange contained a few cable heads, many "bluestone" batteries, a most assertive "pole-changer" and one ringing generator driven by a water motor, the whole festooned with wires of all kinds and sizes and varieties of intractability. Then came the Hibbard distributing board (see *Electrical Engineer*, Oct. 15, 1890) to reduce the wiring to order, and a little later the motor generator displaced both the blue-stone batteries and the belt-driven ringer. A few years later the bridging-board with self-restoring drops called for storage battery and charging generator, and the power plant began to assume proportions. At the same time the distributing board was modified and improved and the intermediate distributing board took definite and imposing shape, though still tending to cling to the switchboard proper. Cable heads poked themselves up from the cellar to the top floor and ranged themselves alongside the distributing board, which annexed to itself the protectors that had formerly garnished the cable heads. The next stage was the relay terminal room in all its glory, occupying nearly as much space as the operating room itself and with its tiled floor and array of glistening machinery presenting the appearance of what the French would call a *salle des machines*. The cable heads, too rashly assertive, were all cut off, and the cable conductors joined directly by means of pot-head joints to the cable side of the distributing board. The intermediate distributing board at last found its proper place in the terminal room, adjacent to the main distributing board, thus bringing all the work of cross-connecting into one department. The relay racks came into being, and the storage battery, from the modest two cells required to work restoring coils, grew to impressive size, requiring corresponding increase in

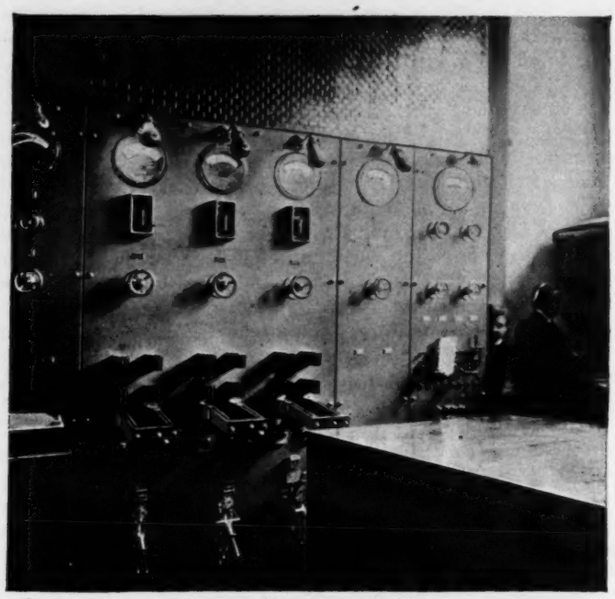

FIG. 3.—MAIN SWITCHBOARD POWER PLANT.

motor generator plant, while the various refinements of automatic ringing, "busy-back" and "don't-answer" signals, testing currents, and so forth, each called for special machinery to furnish the various specialized currents.

The display of machinery in the terminal department of the new Cortlandt Street exchange loses somewhat in effectiveness through the distribution of the appliances among three floors, the seventh, eighth and ninth of the annex recently added to the building. The underground cables come up a shaft in the eastern wall of the building and are directly connected, passing through the ceiling of the seventh floor, by pot-head joints to the main distributing frame on the eighth floor. On the ninth floor are the intermediate distributing board, the relay racks, the power switchboards and the storage battery, which occupies all one end of the room, 22 ft. in width. The generators for charging the storage battery, of which there are three of a total capacity of 55 kilowatts, driven by direct-coupled electric motors supplied at will either from the house or the Edison mains, are distributed among the three floors. A power table of slate in a steel framework carries two motor-generators for ringing and two for supplying special current for signals and tests. The fuses for protecting the relays and coils from heavy currents are all mounted on slate bases. A useful and time-saving wrinkle is the provision of a set of annunciators and alarm bell by means of which attention

is imediately attracted to the blowing of a fuse and the particular fuse blown is indicated by the drop which has been operated.

On the eighth floor is a four-position wire chiefs' desk, completely fitted with testing lines running to various parts of the switchboard and distributing frames, and with appliances for testing lines for trouble. A complete pneumatic tube plant has been installed for transmitting trouble reports between the manager's and the monitor's desks and that of the wire chiefs'. A remarkable feature of this wire chiefs' desk is that it is hinged to the wall at one end and the entire desk can be swung out or back according to whether it is in use or not. The limited space available in the three floors devoted to terminal equipment and power plant rendered desirable this bold treatment of a heavy switchboard, for such the wire chiefs' desk really is. It is probably the first movable switchboard on record, even though its movement is confined to swinging at anchor through a comparatively small arc. The power plant and terminal equipment, notwithstanding the extremely compact arrangement of it all, occupy a total of close on 3000 sq. ft. of floor space, or about half as much as the operating room itself.

The completion of the new plant puts out of service not only the old switchboard, but the old terminal room and distributing board which formerly occupied one-half of the basement of the Cortlandt Street building. This basement, about 100 ft. by 20 (described in the *Electrical Engineer* for Oct. 15, 1890) had gradually filled up with cable heads and distributing frame until it was a veritable cave of the wires, with scarcely room left for another cable to wriggle in. On the night of Nov. 2 a dismal scene of destruction was visible here, as workmen were engaged in cutting away and drawing out the dead ends of cables that were being put out of service as the new branches to the new board came into action. The work of connecting the underground cable system of the district to the new plant involved extensive changes not only in the exchange vaults, but in 19 other manholes in the neighborhood. All of this work was carried out practically without an error, and when the transfer of the service was complete it was found that the largest exchange of the system, comprising, between subscribers' lines, trunks, private wires and other miscellaneous wires, some 10,000 metallic circuits, had been made with fewer actual "troubles" than had arisen from any previous transfer of the smaller exchanges. Of course, since eight other exchanges had been changed over from magneto to relay working, and three new relay offices had been connected to the underground system, the staff had had some practice, but still the record is a fine one, both on account of the magnitude and immense detail of the work involved and the thorough success of the result. The enthusiasm of the men concerned in actually carrying out the work was a fine thing to see. One of the engineers in charge of the cable work told me that two of his splicers who were not required on the cut-over had offered to work all night without pay, so eager were they to share in the great job, and a foreman who had been told that he would not be needed was found in his shirt sleeves helping to pull out dead lengths of cable. It reminded me of old submarine cable days when the whole ship's company would sit up to the gray dawn to take part in lowering a "final splice" overboard.

Another interesting fact relating to the staff is that the whole Cortlandt Street operating force begged, as one woman, to be allowed to take up the working of the new board from the very beginning. Previous practice had been on starting a new relay exchange to draft a force of experienced operators from other relay offices. The change was extreme from the old magneto board to the new common battery board, and the very fact that the working of the latter is so simple makes it all the more easy to make mistakes, while there was the general difference in the style of the operators' equipment also to be considered as a factor. However, such enthusiasm on the part of 150 earnest and hard-working young women was not to be resisted. The whole day force turned up for duty on Sunday morning, the night force having already seen the new board's first gleams of activity as the transfer was made. Sunday, therefore, when the Cortlandt subscribers were at church (or at golf), gave the Cortlandt operating force opportunity for a full dress rehearsal, as it were, in anticipation of the crowded "first day" that was inevitable on the morrow. This opportunity was availed of to become familiar with the new equipment, the arrangement and numbering of the jacks and all the details that differed so widely from those of the old board, which had been working at full pressure (in fact, at forced draft, since everybody tries to do a day's work in three hours on Saturday), only the day before. The result justified fully the enthusiasm of the operators and the judgment of those who allowed it to have sway. The first week's work gave five exceptionally busy days, the day before and the day after election day naturally giving far above normal traffic, yet everything went as smoothly as—well, as a relay exchange well operated, and for the whole week there were but two written complaints bearing on the Cortlandt Street service to be dealt with by the traffic department.

The new switchboard, which was all ready for business early on Sunday morning, but naturally had little or no business to do on that day, had its first real day's work on Monday, Nov. 4, the day before election day. That day, coming between a Sunday and a legal holiday, was, as expected, a record breaker, and gave the largest volume of telephone traffic that Cortlandt had had in several months. The new plant did itself proud in every respect, and under as hard a test as could be wished for came out with flying colors, for the record of troubles and complaints was actually smaller than had been experienced for a long time; in fact, the new board worked from the beginning exactly as if it had been long in use, and had thoroughly struck its gait, and by noon of Monday the manager of the exchange serenely stated that there was no "new" board, that the exchange had settled down to work with all the steadiness of an old and practiced hand.

Another Automatic Telephone Exchange in Massachusetts.

IN November, 1900, the first automatic telephone exchange in Massachusetts went into operation at New Bedford, and a description of that system appeared in these columns Feb. 9, 1901. It is now possible to present the financial and physical facts relative to the second exchange of this type in the State, namely, that at the neighboring city of Fall River.

This second exchange, like the first, has been constructed and is operated under license of the Eastern Automatic Telephone Company, of John Hancock Building, Boston. The company last named is in turn the exclusive representative in the States of Massachusetts and Rhode Island of the Strowger Automatic Telephone Exchange Company, of Chicago. Mr. Vinton A. Sears, vice-president of the Boston company just named, is also one of the directors in the local telephone company at Fall River. This latter company is organized under Massachusetts laws, with an authorized capital stock of $135,000, of which $130,000 has already been issued. Work on the Fall River automatic system began in January, 1901, and service to subscribers commenced in September last. At this writing 615 subscribers are served by the exchange, and additions are rapidly being made.

A fireproof building of brick, one story in height, with basement, and about 38 by 60 ft. on the ground, has been erected by the Fall River Company for the exclusive use of its exchange. The ground floor of this building is of concrete arches between steel beams, the roof is tar and gravel, supported by steel beams, and the interior columns are iron. On the interior the building is finished with glazed brick to some feet above the floor. The cost of this building has been about $11,000. All telephone cables pass from the switchboards and apparatus on the first floor to the basement of the exchange building, and thence through a brick subway to the ends of the conduits under the street. Vitrified clay conduits to the length of 120,000 ft. have been laid in about five miles of trench. Manholes to the number of about 60 are provided to give access to the conduits at intervals of somewhat less than 400 ft. along the trenches. The conduit thus far installed has cost approximately $25,000 in position. From the ends of the conduits, cables are run overhead to distributing poles, and thence circuits are carried to subscribers. The telephone company has found it unnecessary to erect new pole lines within the city limits, because of a contract under which they have the right to use the poles of the local street railway and lighting companies. In order to connect the Fall River exchange with that at New Bedford, a new line of 35-ft. poles will shortly be erected over the intervening distance of about 12 miles.

This long-distance line will carry at first six or ten wires of No. 10 hard-drawn copper. The clay conduits are all of the multiple duct type, and are large enough for 200 pair cables. Eight cables leave the exchange by way of the basement and the brick subway previously mentioned. Four of these cables contain 150 pairs of wires each, and the other four contain 100 pairs each, making 1000 pairs in all. The entire amount of cable thus far used includes 6500 ft. of 150 pairs, 15,000 ft. of 100 pairs, 20,000 ft. of 50 pairs, 10,000 ft. of 25

pairs, and 5000 ft. of 10 pairs. These cables were all installed by the manufacturers under contract. At the exchange the first floor is devoted to the office and switchboards, and the basement partly to battery and storerooms. The switchboards on the first floor are adapted to receive instruments for 2700 subscribers, the dimensions of the room being 35 by 41 ft.

As fully pointed out in the matter above mentioned on the New Bedford exchange, each subscriber in the Strowger automatic system has an automatic instrument provided for his especial use on the switchboard at the exchange. This instrument takes the place of manual operations in connecting and disconnecting a subscriber to numbers that he calls, or by which he is called. At Fall River, energy to work these automatic instruments is supplied from a storage battery in the basement of the exchange building. This battery consists of 50 cells with 80 ampere-hour capacity, and 50 cells with 20 ampere-hour capacity. Energy to charge these batteries is drawn from the public supply mains. A motor-generator of ⅓ horse-power capacity furnishes the current for bell ringing. Connections are so made through an automatic relay that this motor-generator stops operation during the night when no calls are being made, but immediately starts when any customer makes his connections for a call.

One of the strong arguments in favor of the Strowger automatic system is the low expense of operation at the exchange. This feature is well illustrated in the present instance. The entire care and operation of the exchange at Fall River, serving 615 subscribers, devolves on a single attendant, and the number of subscribers may be increased to 1000 without additional help. This attendant has been connected with telephone work only two years, and is paid a salary of $80 per month, thus showing that the details of the system may be mastered in a moderate length of time.

It seems in this automatic system that the expenses of operation and the fixed charges go up much more nearly in direct proportion to the number of subscribers, than at the higher rates of increase so well known in manual systems. Certain it is that the increase of operating expenses with the number of calls made by subscribers goes on very slowly in an automatic exchange, compared with the like increase of a manual system. This last fact explains the very low rates that automatic exchanges are able to make for unlimited service. At Fall River a subscriber to the automatic system gets a long-distance instrument, a private line and unlimited use as to the number of calls for $36 per year in a business house, or $24 per year in a residence. The rates of the local Bell company at Fall River are said to be $93 and $72 in business houses and residences, respectively, for similar service.

The cotton industry is the leading one at Fall River, and 27 manufacturing corporations in this line are using from one to five telephones each on the automatic system. Practically all of the cotton and cloth brokers, and mill supply houses are also connected with this system. The secrecy incident to the automatic system is evidently appreciated by the physicians of Fall River, 55 of whom are connected to its service.

These important exchanges at New Bedford and Fall River are only the beginning of automatic service in Massachusetts.

At Springfield, in the same State, the Hampden Automatic Telephone Company has already begun the construction of its underground system, and will have an exchange ready for operation in due time.

For the Fall River system the clay conduits were furnished by the American Vitrified Conduit Company. The cables were made and installed by the Standard Underground Cable Company. The storage batteries are of the "Chloride" type, made by the Electric Storage Battery Company. The Holtzer-Cabot Company furnished the motor-generator. All of the automatic telephone apparatus was manufactured by the Strowger Automatic Telephone Exchange Company, of Chicago.

As the automatic exchange employs electrical energy to perform work that would otherwise be done by human hands, it may be asked how the cost of this energy compares with the wages of telephone girls for equivalent work. At the Fall River exchange during the month ending Nov. 27, 76.2 kilowatt-hours were supplied to the storage battery that works the magnets of the automatic instruments. This energy was billed at 10 cents per kilowatt-hour, less 10 per cent, making a net charge of $6.86 on this score. The motor-generator that does the bell ringing absorbed 54.2 kilowatt-hours during this same month, costing at the rate just named $4.88. It does not appear that the consumption of energy by the motor-generator for bell ringing is any greater in the automatic than in a manual system. Considering only the energy supplied to the storage batteries at a cost of 686 cents for the month, it seems that this cost amounted to little more than one cent per subscriber per month, as the number of subscribers was 615 before the end of the month. The total cost of energy at the exchange for all purposes was $11.74, or less than 2 cents per subscriber connected for the month. All of the subscribers connected with this exchange are on unlimited service, and any reasonable estimate of the wages of telephone operators to do equal work is sure to be far in excess of the $6.86, or even of the $11.74, the cost of bell ringing as well as of battery charging.

The Economic Design and Management of Telephone Exchanges—I.

By Arthur V. Abbott, C. E.

TELEPHONIC DESIGN as one department of the great field of electrical engineering has had few exponents, and so far as the writer is aware, there has been no connected exposition of the principles which govern the mutual relations of the various parts of a plant necessary to telephonic service on a large scale, in such a manner as to enable the engineer to so proportion the quantity and quality of the essential apparatus as to produce an installation that will give the best service with a minimum initial investment, and aid the operating manager to so prosecute the business as to insure satisfactory service with the least annual expense.

The reasons for this absence of literature are not far to seek. Telephony as an art is less than a quarter of a century old, and those engaged therein have had to feel their way step by step, usually so handicapped by the demands of a business that was increasing too fast for experience to overtake, as to lack the time and opportunity to record the lessons that actual practice inculcated. Then, for the best part of its present lifetime, the telephone has been under the control of a management that, while it has usually prosecuted the development of the art in a most careful and praiseworthy manner, has steadily indulged in what appears to the author the mistaken policy of repressing free discussion of the subject. This state of affairs is fast disappearing. With the independent movement, exchanges are springing up in each town all over the country, and each state is organizing mutual telephone associations at whose frequent meetings a full and frank interchange of views and experience is exchanged, that the technical press immediately places at the service of those interested, thus imitating the broader and more liberal methods of other electrical interests.

During the experience of a decade in the engineering field of telephony, the writer has had an opportunity to watch the operation of what appear to be some of the fundamental principles of the economic design and management of telephone exchanges. At best these observations can only cover a small fraction of even present telephonic experience, and deductions therefrom must be accepted with the greatest caution, and be subject to extreme modifications both in place and in time. With such restrictions, these notes are now offered for the consideration of those who are, perhaps, in an earlier stage of experience, in the hope that in some cases, at least, they may serve as a guide of what not to do.

THE FACTORS IN THE PROBLEM OF DESIGN.

An attentive observer at the Philadelphia Centennial Exposition could have noticed a fine wire extending along one of the galleries of Machinery Hall. The ends of the wire terminated in curious trumpet-shaped pieces of apparatus, placed in little enclosures situated at opposite sides of the building, wherewith a careful listener, located at one end of the wire, aided by acute hearing, and the judicious use of the imagination, might understand articulated sentences shouted into the apparatus at the other end. Such was the first public exhibition of the telephone.

By means of the invention of Professor Bell, the long-sought electrical transmission of speech became an accomplished fact, and during the quarter of a century which has since elapsed, electrical arachnida have been so industriously spinning a copper net over the continent, that in the United States alone, there are approximately a million miles of telephone wire, bringing into daily speaking relations about two and a half millions of subscribers; that with 3,000,000 telephones, annually exchange nearly 4,000,000,000 messages, while for the prosecution of this business some tens of thousands of employes are needed.

Though Professor Bell's discovery richly merits the distinction of

being the keystone of the stupendous telephonic edifice that has since been reared, yet the present value of the telephone and its influence in business and social intercourse depend quite as much on other and auxiliary apparatus that, voussoir-like, supports and sustains the key, and is equally necessary to complete the magnificent structure. Bell's magneto telephone supplied an instrument for mutually interconverting sound and electricity—absolutely nothing more. But to render inter-communication practical, calling signals were needed, for, although the telephone could talk, its voice was too feeble to gain notice, and such a contrivance was required as would at once attract the attention of those in the vicinity of the instrument, without requiring watching, and also one that would be perfectly reliable and need no attention to keep in constant repair. Without an exception, all forms of signals for subscribers, excepting the audible one, have proved to be failures, and while multitudes of devices involving the use of the receiver or an electro-magnetic tuning fork arranged to emit a musical note have been tried, all have been relegated to obscurity save the familiar call bell.

In early days the old-fashioned vibrating bell, with battery and push button was immediately at hand, and gained a widespread introduction; but the battery was inconvenient to maintain and the bell contacts got out of order, so the magneto bell, containing no contacts, operated by a small electric hand dynamo, displaced in the race for survival, the electro-chemical signal.

Experience soon proved that the magneto telephone was exceedingly inefficient in the transmission of speech, as it could only be used over short lines, and even then necessitated the expenditure of much lung power at the sending end. No sooner did Bell's instrument appear than a host of experimenters set to work, and presently the microphonic inventions of Berliner, Gray, Hughes, Edison and Blake completely displaced the Bell telephone for all purposes of transmitting speech. The Bell type as a receiver, however, still holds undisputed sway in almost the identical original form. So by the schooling of experience a telephonic outfit for the subscriber has been refined to a magneto signal, a battery transmitter and magneto receiver.

In addition to talking and signaling apparatus for the telephone user, a path over which electrical energy could travel between correspondents was required, for in early telephone days Hertzian waves were entirely unknown, and even to-day their telephonic possibilities are of the remotest. Hence the unsightly aerial lines which grew like mushrooms, exhibiting with their crooked knotted poles, top-heavy with almost impenetrable cobwebs of wires, and loaded with wrecks of innumerable kites, many other cryptogamic resemblances. Gradually, however, the open-wire line evolved into the aerial cable, and from the aerial cable developed the much more satisfactory underground system that now only betrays its presence by periodically recurring upheavals of the streets, and a chronic disease of city pavements. In the beginning, each person was compelled to have a separate line extending to every other with whom conversation was desired, though with the first handful of telephones installed, the absurdity of this method from both the standpoint of expense and intricacy was demonstrated. To reduce the number of wires to a minimum, only a single one was strung for each pair of communicants, Mother Earth being used as a common return, but like all garrulous gossips she caused trouble by failing to hold her tongue, creating no end of domestic disturbance by surreptitiously informing Mrs. X. what Mrs. Y. had ordered for dinner. Then when the electrical railway, and electric light made their appearance conversation of all kinds was so interjected with such a hissing and spitting that telephonists were fain to immediately convert each line into a complete metallic circuit.

As an escape from the impracticability of a wire for each pair of talkers, came the germ of the modern exchange in the idea of bringing all lines to some central point. At first the attendant carefully and laboriously wrote out the message that the calling party wished to transmit, summoned the desired correspondent and yelled the message into a plain magneto-telephone (for in those days there were no solid backs), this performance requiring a sufficient expenditure of lung power to enable the recipient of the message to receive the same independently of the telephone, provided he happened to be within a few blocks of the office. But this plan limited the use of the telephone to messages which were purely mandatory, and as people wanted to converse with each other, some means of interconnecting different lines was needed. The old telegraphic device of interlaced brass strips was the next step in advance, by means of which, with the aid of plugs fitted into holes in the strips, any pair of lines could be promptly joined together. This plan worked with fair success until the number of subscribers so increased as to require a greater space for the strips than could be covered by the arms of four operators seated at a square table. At this point the invention of the spring jack, and flexible cord terminating in a metallic plug, whereby any two jacks each attached to a subscriber's line could be quickly and surely connected, afforded immediate and seemingly permanent relief. But the increase in business has been so rapid that the ingenuity of inventors has been taxed to the utmost to reduce the jack to its least dimensions, in order that all the subscribers brought to one office could be placed within an arm's reach of the operator. Hand in hand with the evolution of the spring jack and connecting cords, the development of central station signals has taken place, for the switchboard requirements are very different from those of the subscriber. At the office an attendant is supposed to be constantly on duty to watch signals, but it was essential that the party calling should be plainly identified—a function entirely unnecessary at the subscriber's premises. The call bell was tried, but found too bulky and indistinctive. The electromagnetic annunciator in the form of the familiar hotel apparatus equipped with a falling shutter, or drop whereby a number painted thereon could be displayed at the subscriber's pleasure, reigned supreme for more than a decade, but the decreasing size of spring jacks with which the signal must be associated, and the demands for service that should be surer and more prompt, has consigned the drop to the scrap heap, and substituted therefor a miniature incandescent lamp, that is now universal in modern switchboards. So, from a little table in a small room in Devonshire Street, Boston, to which a half dozen magneto telephones were connected by iron wires strung in streets, the modern telephone system of the country has evolved, counting its subscribers by millions, and talking with ease over half the continent.

Every telephone plant, therefore, may be structurally divided into three separate parts, that perform entirely different and separate functions, the sum of which is necessary to the prosecution of the business. These parts are:

First.—*The subscriber's station,* containing apparatus to enable the user to transmit signals to and from the office and to transmit and receive conversation.

Second.—*The line,* comprising the necessary wire plant to supply electrical communication between each subscriber and the central office, and between different central offices.

Third.—*The central office,* comprising apparatus capable of performing the following functions:

First.—(a) To permit any subscriber to call the attendant at all times.

(b) To permit any subscriber to give necessary instructions to the attendant.

(c) To permit the attendant to ascertain whether any subscriber is engaged in conversation without causing interruption.

(d) To permit the attendant to call any disengaged subscriber.

(e) To permit the attendant to connect together any two parties for conversation.

(f) To notify the attendant at once when conversation is completed.

Second.—To enable attendants to perform the same functions between different offices.

The *Economic Design* of a *Telephone Exchange* is such a selection and arrangement of apparatus and appliances for each of the factors thus defined, and such a mutual adjustment of one to the other, as to enable the particular plant under consideration to give the best service with the least initial investment. The *Economic Management* of a *Telephone Exchange* is such a regular manipulation of the plant as shall secure the best service with the least *continued* annual expense.

In the consideration of the three telephonic factors taken in the preceding order, it is most convenient to commence with the central office as a center and proceed centrifugally outward to the subscriber. Telephonists, however, have a language of their own, partly composed of words and phrases peculiar to the art, and partly of expressions current in electrical and mechanical engineering, to which a specialized meaning, different from that ordinarily conveyed, is attached, and even between experts the same terms are used with varying meaning. It is well, therefore, before proceeding to the consideration of central station design, to rehearse the more common telephonic definitions in order that in future, paragraphic brevity may be combined with perfect definiteness of statement.

Theory of the Edison Nickel-Iron Cell.

BY E. F. ROEBER, PH.D.

I HAVE read with much interest the communication of Mr. Woolsey McA. Johnson, published in your issue of Nov. 2. Mr. Johnson's arguments are quite interesting, but do not appear to be conclusive. He agrees that there will be concentration changes at the electrodes, but he claims that such changes would have small effect on the voltage, and that the steady drop of the voltage during discharge could not be accounted for by the influence of the variations of concentration upon the potential differences between the electrodes and the solutions. His argument is as follows: "The e. m. f. of the nickel superoxide plate against hydrogen would be at different concentrations

$$e_1 - e_2 = \frac{0.058}{2} \log \frac{p_1}{p_2}$$

where p_1 and p_2 are the aqueous tensions of the caustic solutions. A similar formula comes in for the positive plate. This would show that the change from a 20 per cent solution to a 1 per cent solution would make very slight difference in the voltage of the cell (not much over 0.03 volt)."

This argument is not altogether clear. There is no reason apparent why Mr. Johnson should speak of the e. m. f. of the nickel-superoxide plate "against hydrogen." So-called normal electrodes, like the hydrogen electrode (platinized platinum saturated with and surrounded by hydrogen) may often be applied to advantage in scientific researches, but in the present case the hydrogen electrode would introduce only complications. For e_1 would then be the e. m. f. of the combination: nickel superoxide electrode, 20 per cent caustic potash solution, hydrogen electrode, and e_2 the e. m. f. of the combination: nickel superoxide electrode, 1 per cent caustic potash solution, hydrogen electrode. Hence the difference $e_1 - e_2$, as defined by Mr. Johnson, would not give the variation of the potential difference between the nickel superoxide plate and the solution alone, but as well as the variation of the potential difference at the hydrogen electrode, and the variation of the e. m. f. at the hydrogen electrode, is of no interest whatever in the present case.

What would be important to calculate is evidently the difference $e_1 - e_2$, where e_1 is the potential difference between a nickel superoxide electrode and a 20 per cent *K O H* solution, and e_2 the potential difference between a nickel superoxide electrode and a 1 per cent *K O H* solution. Now, this difference, $e_1 - e_2$, may indeed be represented by the formula, given by Mr. Johnson, as a consequence of Nernst's theory of the potential difference at a "reversible electrode"; but p_1 and p_2 have then a peculiar meaning, and when this is clearly understood, it is impossible to use the formula for deducing the special conclusion given by Mr. Johnson. To prove this claim, I will give a very brief analysis of Nernst's formula, as far as necessary for the present case.

Nernst's theory deals with the e. m. f. produced at the boundary surface of an electrolyte and a "reversible electrode." What is meant by a "reversible electrode" can best be explained by a few examples. When the transport of $2 \times 96{,}540$ coulombs from a copper electrode to a copper sulphate solution is combined with the passage of one gram atom of *Cu* from the electrode into the solution; and when the transport of the $2 \times 96{,}540$ coulombs in the opposite direction is combined with the deposition of one gram atom of *Cu* from the solution to the electrode, the copper electrode in the copper sulphate solution is called reversible in regard to the *Cu* ions. In the same way, a zinc electrode in the solution of a zinc salt is reversible in regard to the *Zn* ions. A mercury electrode, covered with a layer of calomel (Hg_2Cl_2), in connection with a solution of a chloride, is reversible in regard to the Cl ions.

When one gram molecule of a gas is brought from the pressure p to the pressure $p - dp$, the work performed is

$$v\,dp = \frac{R\,T}{p}\,dp;$$

the work corresponding to the change from the pressure P to the lower pressure p_1, is, therefore, for one gram molecule,

$$R\,T\,l\,\frac{P}{p_1}$$

and for one gram equivalent

$$\frac{R\,T}{n}\,l\,\frac{P}{p_1}$$

where n is the valency and l represents Naperian or natural logarithms.

According to Van't Hoff there exists an analogy between the laws of pressure of gases and those of osmotic pressure in solutions. Hence the last equation also represents the work corresponding to the change of one gram equivalent of an ion from the osmotic pressure P to p_1 in a solution.

Now consider an electrode reversible in regard to the cation (like copper in copper sulphate). Let 96,540 coulombs pass from the electrode to the solution, so that $\frac{1}{n}$ gram molecule of that kind of ion, in regard to which the electrode is reversible, passes from the electrode to the solution, and is brought from what Nernst calls the "solution tension" of the electrode to the osmotic pressure of the same ions in the solution. The work performed is then also represented by the last formula, if P now means the solution tension and p_1 the osmotic pressure in the solution of that kind of ions, in regard to which the electrode is reversible. The work performed is also the product of the number of coulombs and of the potential difference e_1 between the electrode and the electrolyte, so that, after some transformations, we get for $T = 290$ (17 degs. C.), the potential difference e_1 in volts, or

$$e_1 = \frac{0.058}{n} \log \frac{P}{p_1} \qquad (1)$$

where log represents common logarithm, P the solution tension and p_1 the osmotic pressure of that kind of ions, in regard to which the electrode is reversible.

Now take a case exactly like that just considered, except that the osmotic pressure of the ions in regard to which the electrode is reversible, is different from before—say, p_2 instead of p_1. The e. m. f. between electrode and solution is then

$$e_2 = \frac{0.058}{n} \log \frac{P}{p_2};$$

hence the difference of the e. m. f.'s in the two cases

$$e_1 - e_2 = \frac{0.058}{n} \log \frac{p_2}{p_1} \qquad (2)$$

where p_1 and p_2 are the values of the osmotic pressure of that kind of ion, in regard to which the electrode is reversible. We have developed this formula under the assumption that the electrode is reversible in regard to the cation. If it is reversible in regard to the anion, the following formula is obtained, which differs from (2) in the sign,

$$e_1 - e_2 = \frac{0.058}{n} \log \frac{p_1}{p_2}$$

The osmotic pressure of a kind of ion is proportional to the concentration of the same kind of ion, so that instead of the ratio $\frac{p_2}{p_1}$ in (2) we can write $\frac{c_2}{c_1}$, where c_1 and c_2 are the concentrations *of that kind of ion, in regard to which the electrode is reversible.*

Mr. Johnson gives the same formula, but says that p_1 and p_2 are "the aqueous tensions of the caustic solutions." This is not clear; but he evidently means the osmotic pressure of the K ions or of the O H ions. This osmotic pressure is proportional to the concentration of K O H; hence, under the assumption that the one K O H solution is 20 times more concentrated than the other, he gets

$$e_1 - e_2 = \frac{0.058}{2} \log 20 = 0.038 \text{ volt}$$

"not much over 0.03 volt." This conclusion is wrong, because the nickel superoxide electrode cannot simply be assumed to be reversible in regard either to the K ions or the O H ions.

Mr. Johnson's conclusion would be right if we had to deal with copper in copper sulphate, for the ion in regard to which the electrode is here reversible is copper, and the osmotic pressure of the copper ions is in this case directly proportional to the concentration of the copper sulphate solution. The difference between the e. m. f. at a copper electrode in a 20 per cent sulphate solution and the e. m. f. in a 1 per cent solution, would, therefore, be represented by equation (2), where, instead of the ratio of the osmotic pressures of the Cu ions, the ratio of the concentrations of the copper sulphate solution

would be used (always assuming, for the sake of argument, that the theory of solutions which is strictly correct only for very dilute solutions, would also be correct for these more concentrated solutions). In the same way Mr. Johnson's conclusion would also be right for zinc in zinc sulphate, or for a calomel electrode in contact with a chloride solution. But the case of the Edison cell is entirely different. There we have to deal with a nickel superoxide electrode, and with an iron electrode in a solution of hydroxide of potassium. The case is also different with the lead cell, where there are lead peroxide and lead in a sulphuric acid solution. To apply Nernst's theory to these latter cases, it is first necessary to fix exactly the ideas as to the kind of ion in regard to which each electrode is reversible.

There are two different theories of this type for the lead cell, the one developed by Le Blanc, the other by Liebenow. Both assume that the lead electrode is reversible in regard to bivalent positive Pb ions. As to the peroxide electrode, Le Blanc assumes it to be reversible in regard to fourvalent positive Pb ions, while Liebenow assumes it to be reversible in regard to bivalent negative PbO_3 ions. With these assumptions, it is possible to apply Nernst's formula (1), in which, of course, p_1 is the osmotic pressure of that kind of ion, in regard to which the electrode is assumed to be reversible (Dolezalek, *Zeitschr. f. Elektrochemie*, 1899, May 25; Abel, *Zeitschr. f. Elektrochemie*, 1901, June 27). This leads to equations representing the e. m. f.'s as functions of ionic concentrations of hypothetical kinds of ions, in regard to which the electrodes are reversible. Later on, the law of chemical mass action enables one to pass from those hypothetical ionic concentrations to the measurable concentrations of sulphuric acid. Both Liebenow's and Le Blanc's theories lead to the same results, and which are in agreement with the facts. The method just indicated is somewhat long, but is the only correct method to apply Nernst's formula (1) in such cases. To apply it to the problem of the Edison cell, it would, therefore, be necessary, first, to form exact ideas as to the kind of ions in regard to which the electrodes are reversible, and then to apply formula (1), where P represents the solution tension and p_1 the osmotic pressure of these ions.

Mr. Johnson's argument thus breaks down and the question of the influence of concentration changes at the two electrodes upon the e. m. f. of the Edison cell is still an open question. I also believe that the other question taken up by Mr. Johnson, concerning the effect of changes in the internal resistance, can be answered successfully only by experiment, as it seems to me impossible to devise a *priori* an exact mathematical theory, taking into account all the various influences which bring about a change in the internal resistance.

An Association of Ohio Farmers' Telephone Companies.

The Geauga County Telephone Association, which was formed as an association for mutual benefit by five exchanges in Geauga County, has been reorganized and made stronger by the admission of the Chagrin Falls Telephone Company, of Chagrin Falls. The association is unique in several respects, and it represents what is probably the most complete system of farmers' telephone lines in the country. The original association was formed in 1898 by the Bainbridge Telephone Company, the Chardon Telephone Company, the Burton Telephone Company, the Stafford Telephone Company, of Newburry, and the Claridon Telephone Company. The companies were independent of one another, but under the association agreement the subscribers of one exchange was permitted to talk to subscribers of all the other exchanges without extra charge. Under the reorganization, the advantages are increased, since the Chagrin Falls Telephone Company has connection with Cleveland and the long-distance lines of the United States Telephone Company, thereby giving the association the benefit of the long-distance service. The subscribers in the most remote portion of the county will be enabled to talk to Cleveland subscribers at the Chagrin Falls rate, 10 cents. At present the telephones of the association number over 1000, divided as follows: Bainbridge, 150; Chardon, 355; Burton, 150; Newburry, 150; Claridon, 50; Chagrin Falls, 220. Since the entire population of Geauga County is only about 14,000, it is evident that the lines of the association reach nearly half the homes in the county. New officers of the association were elected as follows: Charles Post, Bainbridge, president, and H. C. Tuttle, Burton, secretary. It is the intention of the association to make important extensions of the toll service and lines will be built into eastern Cuyahoga County, northern Portage County and northern Summit County. It is probable also that other towns in these counties will be admitted to the association. One of the greatest benefits of the association is that all materials and equipments are purchased in bulk and are standard, thereby effecting a great saving to the different companies.

The Debt of Electrical Engineering to C. E. L. Brown—IV.

By B. A. Behrend.

THE LAUFFEN TYPE GENERATOR.

THE first and most needful step was to make a generator that could be used equally well for single-phase and for polyphase currents. Thus Mr. Brown invented and designed the "Lauffen Type" represented in Figs. 18 and 19.

In his Frankfort lecture of Feb. 9, 1891, Mr. Brown thus describes the main principles that guided him in creating this construction. "The generator must be an alternating-current dynamo, whose tension we will choose as low as possible, for thus such a dynamo can be made a *machine* in the fullest sense of the word. This will be clear if I adduce as illustration the winding of the armatures of the dynamos designed for supplying three-phase currents to the Oerlikon Tool & Engine Works, which consists of copper bars 30 mm. thick, which are insulated with paper tubes. It may surprise you to hear that the winding of a dynamo may consist of thick, solid copper bars, but this construction becomes possible if these bars are lodged in closed slots in the armature iron, a construction which I used as early as 1885 in my ordinary direct-current dynamos. If you consider an armature of 40 volts consisting of solid bars firmly held in

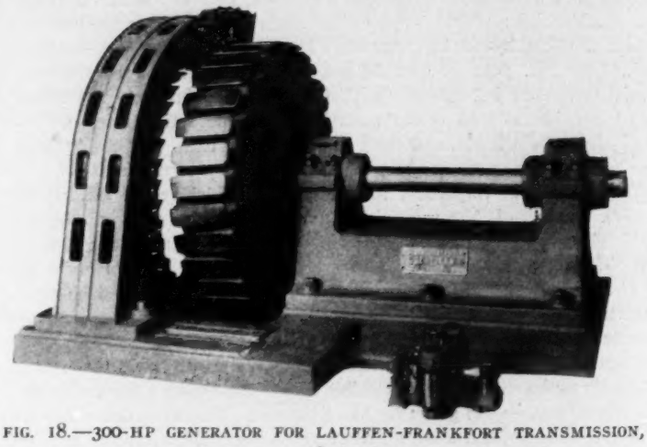

FIG. 18.—300-HP GENERATOR FOR LAUFFEN-FRANKFORT TRANSMISSION, 1891.

an iron core, you must admit that this machine will satisfy the severest claims on safe and dangerless operation."

At the outset of this article we quoted Professor Amsler Laffon's words that the success of Brown's dynamos must be ascribed to his "ingenious though simple" constructions, and the truth of this saying is borne out by the machines illustrated in Figs. 18 and 19. The magnet-wheel is overhanging, the exciting current is led to the field coil by two copper wires that run like belts on the slide rings. The armature can be moved aside to expose itself and the field. The armature winding of these machines consists of round bars, one bar per pole and per phase, which are connected in Y. In the photograph the form of the end connectors is clearly visible. This latter construction also originated with Mr. Brown.

The field coil consists of one circular bobbin placed between the two steel rings with pole projections. This construction, which found numerous imitators, did not prove so successful as its ingenious simplicity might suggest, the reason being the great field leakage. Brown soon became alive to this inherent defect of his machine, and he at once discontinued building it, while his followers, with the imitativeness of our species and with the inertia characterizing the human mind, did not even see its seeming advantages until its inventor had long discarded the construction.

The effect of leakage in the Lauffen type shows itself in making the short-circuit curve bend off at high saturations so that doubling the exciting current, for instance, does not increase the short-circuit

current more than about 25 per cent. The saturation curve being almost parallel to the abscissa, owing to the leakage, it follows that with increasing excitation the drop is not diminished as it is in machines with small leakage. Thus it happened that machines built after the Lauffen type and operating on an inductive load, did not give the calculated terminal volts, however much the exciting current might have been increased. To grasp these facts, so important and yet so long persistently misunderstood, is one of Mr. Brown's greatest achievements, or, we had better say, the fact of his understanding it at a time when most electricians were floundering from one chaos of prejudices into another, and vacillating from one type to another, led of necessity to the start that he soon obtained over them.

In October, 1891, Mr. Brown left the Oerlikon Company after having been their designer and director for six years. For Mr. Brown is proud of calling himself a designer, as it is his superior designing ability that established the high reputation of the Oerlikon Company, leading not only in design but also in workmanship; and those who admire the work of Brown cannot fail to yield their appreciation and esteem to Colonel Huber, the president of the Oerlikon Company, for having been wise and large-minded enough to have seen the worth of the young director of his plant. For it doubtless redounds greatly to the credit of a man's intellect who, in an executive position, is capable of discerning between the shallowness and tall talk of the bully and the more modest claims of the truly able man. That the designer, aside from questions of organization and

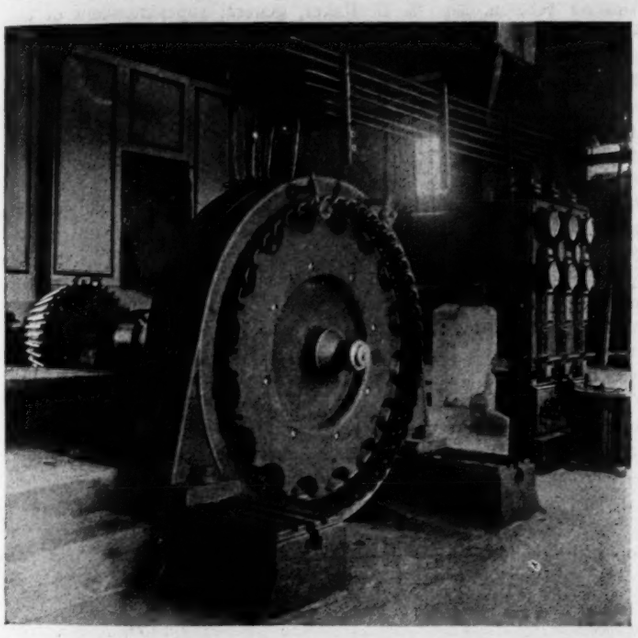

FIG. 19.—300-HP GENERATOR FOR LAUFFEN-FRANKFORT TRANSMISSION, 1891.

management, in large measure makes and unmakes a concern, has been experienced by many a large concern during the past ten years.

In his new works at Baden Mr. Brown devoted all his energies to the practical development of alternating-current machinery. We have seen that Brown had already recognized the inherent faults of his Lauffen type. With keen penetration he took up the revolving field alternator and made it the successful machine that this type is now acknowledged to be all over the world. The condition in which Mr. Brown found the revolving field machine when he began to improve it, was not a very encouraging one. Indeed, these machines were then such freaks that it was hard for a man to see which was the armature and which was the field, as the former had tremendous holes filled with wire, while the latter contained only a few thousand ampere turns, so that the amount of copper on armature and field was almost the same. As a great advantage of these machines was put forward that the danger of their burning out was diminished to a minimum since the short-circuit current did not exceed—often it did not even equal—the normal current of the machine. A certain popular saying about the fox and the sour grapes he could not get, intrudes itself somewhat involuntarily upon the modern designer when he listens to such claims. These machines were very wide, they had poor ventilation, they had a small pole-pitch and a large air-gap; in short, they were the embodiment of all the errors that designers could make. In the hands of Mr. Brown the revolving field generator received its modern form and shape, as we will illustrate by two splendid designs, viz., Brown's design for the Cataract Construction Company, Niagara Falls, and for the Frankfort Electric Central Station, Germany.

In Fig. 20 we give the design of the 3500-kw generators that Mr. Brown submitted to Professor Turettini successively on April 1 and Sept. 20, 1892. This machine was designed to give two-phase current

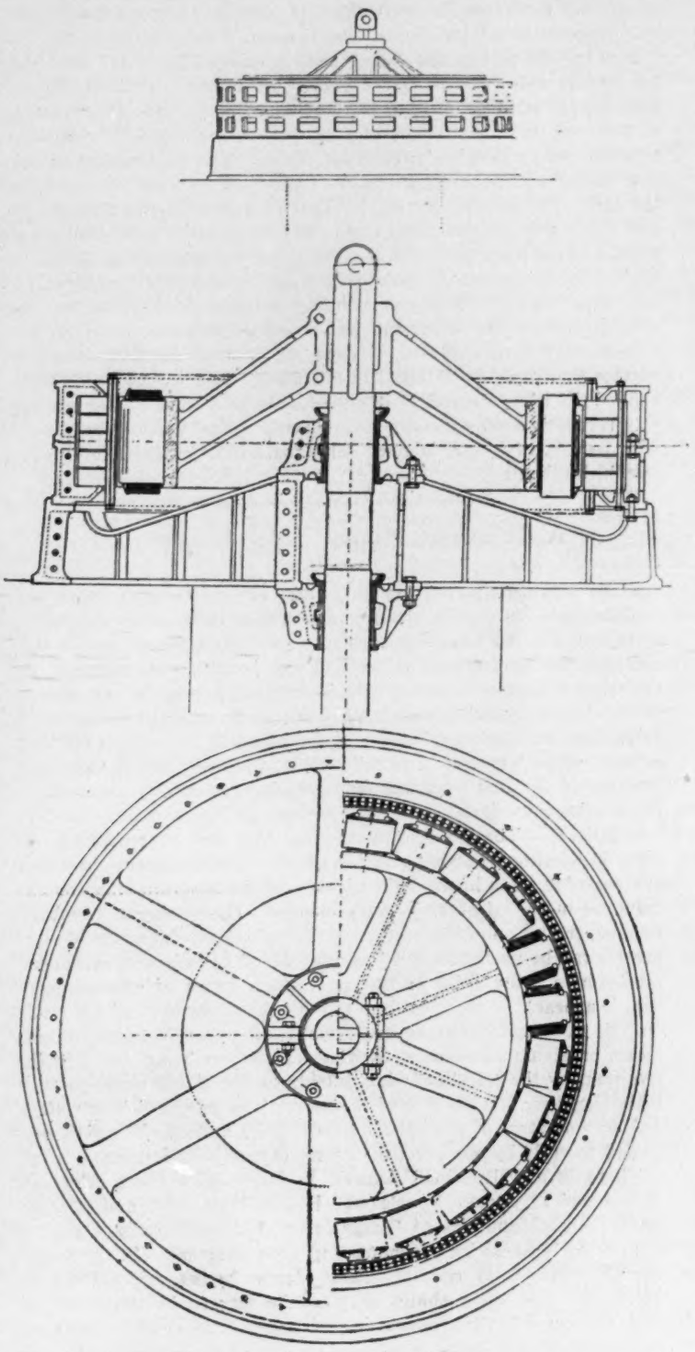

FIG. 20.—BROWN'S DESIGN FOR 3500-KW GENERATORS FOR CATARACT CONSTRUCTION COMPANY, 1892.

of 50 cycles at 3000 volts and 582 amperes. The speed of the generator was 250 r. p. m.

This design is in all respects a modern one. The diameter of the revolving field, which is a single steel casting, is 300 cm., hence the surface speed is nearly 40 m. per second, or 7800 ft. per minute. The total width of the armature iron is 60 cm. There are eight slots per pole, four per pole and phase, each slot containing two conductors. The total flux per pole is, therefore, 14×10^8. The section of the pole

is $20 \times 55 = 1100$ cm²; thus the induction in the pole bottom with 20 per cent leakage comes out to be 15,300 per square centimeter. The ventilation of the armature is very carefully attended to, which would have permitted the making of the machine as small as it was proposed. For the interest of the comparison it may be mentioned that the present Niagara generators, designed by the Westinghouse Company, have a diameter of 262 cm. and are 90 cm. wide.

Mr. Brown intended to make the field coils of these high-speed machines of copper strip wound edgewise upon the poles, a construction that he put into practice a little later in 1893 on a 600-hp single-phase generator in Lucerne, while the 525-kw single-phase generators for Frankfort were the first to draw general attention to this "ingenious though simple" construction.

Perhaps the first to use copper strip wound on edge was Mr. Sebastian Ziani de Ferranti,[1] who recently wrote to the author: "I first used copper winding on edge for field magnets (of disk alternators) in the year 1883. This particular machine was fitted with a zig-zag armature and was a low-tension alternator. The field magnets were not wound with separate coils, but the strip was wound on edge in the form of a zig-zag. No insulating covering was used on the strip; one layer was divided from the next by means of little insulating pads, and the strip was held in position on the magnets by means of four wooden wedges per pole driven in at the corners between the iron magnets and the copper winding. This field winding was in consequence air-insulated, and had most perfect insulation of air round every part, and also exposed the greatest possible radiating surface that could be obtained in the space available." Mr. Ferranti applied the edgewise coil in 1890 to his mercury meters, and in 1893 to a revolving field generator with circular poles made of cast steel, with pole faces forged in one. This machine is installed in Portsmouth, England.

A Telephone Money Order System.

From time to time efforts have been made to engraft upon the ordinary telephone service various features of information or amusement that the public is supposed to need. Many years ago in this country, the time system of a Southern jeweler was taken up by capitalists interested in the Erie Telephone Company, but after a pretty thorough trial it was dropped from all the Bell circuits, there being then no others available. So far as could be learned, the time system, while ingenious and practicable, was a nuisance, and since that period the Bell telephone managers have been very chary about introducing auxiliaries and accessories, shying even at sanitary mouthpieces. The desirability of repeaters and of recording devices is admitted, but none are available at this moment, and they are regarded more in the light of parts of the apparatus than as extraneous means of earning extra income. The Budapest telephone newspaper is a good illustration of the extent to which this kind of service can be pushed, but it has quite failed of imitation elsewhere, although in some cities in Europe various forms of entertainment can, it appears, be switched into any house on payment of the tariff. In this country one hears occasionally of people listening to sermons, or giving evidence, or getting married, or being called in the morning, by the telephone; but outside of fire alarm work, there is little telephone service here of the nature now proposed by *Printers' Ink*, in the nature of a telephone money order system. The plan suggested recently by our excellent contemporary is as follows:

There is a well-defined demand in large cities for a telephone money order system. People who live in New York and Chicago and other communities of "magnificent distances" transact a great volume of business by telephone, and even telegraph. In the ordering of theater seats, concert tickets, sleeper berths, railroad tickets, staterooms and other things that can be secured by telephone the main difficulty is the transmitting of money. Seats and tickets are often forfeited when not claimed upon the minute by parties who have no accounts with theaters, and it is next to impossible to convey money by any convenient, inexpensive method. If a reliable system of stations were established where money could be paid and transmitted by telephone it is likely that urban telephone money order business would be greatly increased. Improved money order systems have done much to increase the volume of trade in the rural districts of the land, and there is no reason why they could not be made to do as much for the cities.

In order to ascertain what there is of value in this suggestion, we have brought it to the attention of a number of well-known telephone managers and engineers in this country, and some of their replies are given below. Mr. W. D. Sargent, vice-president of the New York & New Jersey Telephone Company, one of the oldest and most experienced telephonists in America, says: "The prime function of a telephone company is to furnish wires and apparatus for the purpose of oral communication to all who may apply for it. At the present time, when the business is in process of development, I do not think it would be wise or expedient for telephone companies to attempt any side business. No doubt they will do so in the course of time. We have never done anything in the line of your memorandum. We do not even receive, transmit or deliver written messages. I understand the transmission of money orders by telegraph is a profitable business to telegraph companies, and there is no reason why it cannot be done just as well by telephone by any financial combination that would choose to use the wires for that purpose." Another veteran, Mr. E. B. Baker, general superintendent of the Southern New England Telephone Company, says: "I do not know of any instance where this has been adopted by telephone people, although I have often considered the matter of purchasing theater tickets and steamship staterooms for our subscribers located in adjoining exchanges, the subscriber paying the ordinary telephone tolls and messenger charge in addition to the price of the tickets. I think this would be perfectly feasible, besides being an accommodation to the public, and I do not see why the same could not be followed out in regard to money orders." Mr. U. N. Bethell, the general manager of the New York Telephone Company, who was formerly in Brooklyn and lately has had the Washington Bell system entrusted to his care, writes us that the suggestion is "a very interesting one," and adds: "Nothing of the kind has ever been attempted within my knowledge, and no feasible way of carrying such a business on occurs to me." Mr. Angus Hibbard, general manager of the Chicago Telephone Company, remarks: "I do not know that I have any opinion on the matter referred to in your note which is worth anything. It seems to me that in a large telephone exchange local transfers of money can be, and undoubtedly are made through persons or companies acquainted with both parties, making unnecessary the establishment of any particular office or point at which such transfers should be made."

Mr. A. V. Abbott, who was formerly with the Chicago Telephone Company as its electrical engineer and is now actively following his profession in Cleveland, sends us the following thoughtful letter: "Relative to the transmission of money orders by telephone as suggested by enclosed slip, the idea is certainly a novel one, at least so far as my knowledge is concerned, as I never heard of it being previously suggested. In some cases this might afford a convenience to telephone users, but it appears to me that the complications would be so great that the service might become too expensive to be desriable. If the system would be universally extended it would practically amount to requiring a telephone company to open an account with all subscribers, and then each subscriber would have to guarantee all sums transmitted over his instrument. A service of this kind might be popular in connection with long-distance lines in the transmission of money from town to town, and as the volume of this business would necessarily be quite small I am not sure but that it might become a valuable feature for the larger pay stations such as would be located in the downtown exchanges in New York City and Philadelphia and the larger cities, but I should fear, on the whole, that the bookkeeping complications would be prohibitive for anything excepting a few of the largest offices."

Mr. C. H. Judson, of the progressive Twin City Telephone Company, of Minneapolis, Minn., says: "Concerning the demand for a telephone money order system, I am certain that something of this kind in the large cities might prove of great utility. As to the manner of putting this into operation it does not seem to me that it would be at all difficult. A telephone company should be just as

[1] From a letter of Mr. C. E. L. Brown to the writer I wish to publis hthe following paragraph:

"There is a great deal of truth in your remark as to there being very few men who are capable of properly criticising a design. This is a thing I have noticed over and over again, and it has always been a puzzle to me that there should be such a comparatively small number of men—even among engineers—who thoroughly and instinctively comprehend the points of a well thought-out design, and to whom such a design is a source of real pleasure analogous to that felt by any connoisseur for a work of art.

"I would just point to a man whom I regard as being an exceptionally fine designer, namely, Mr. Ferranti. I have met very few people indeed who had the slightest idea of the beauties of his designs."

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able to transmit small amounts of money in this way as a telegraph company, except in that it would require some kind of a check to be certain that responsible parties were making the orders. This, however, should not be difficult. We have not felt the need of anything of this kind thus far in Minneapolis or St. Paul, since our population has not reached the point where parties living at a distance from the theaters cannot have some one conveniently located make their arrangements. Of course, in cities like New York and Chicago, or Philadelphia, where it would not be possible for people living in the suburbs to send any one personally to the ticket office the system should be valuable. I should be very much interested in reading the opinions of other telephone men on the subject, since perhaps they may make suggestions that will give us ideas that would enable us to utilize the service in our own exchanges." Somewhat on the same lines, President S. P. Sheerin, of the New Long Distance Telephone Company, of Indianapolis, Ind., says: "In reply, permit me to say that, while we have no regular system—not having as yet inaugurated it, because of the multiplicity of other things claiming our attention—we do a limited amount of this business. We will buy theater tickets for any of our friends throughout the State, and make any other such purchases or payments for them as they may desire. We intend, just as soon as we can give it sufficient time, to organize a system of this kind, in a very complete way." Mr. G. H. Metheany, manager of the Lima (Ohio) Telephone & Telegraph Company, remarks: "I believe that if a safe system were devised and put in operation a good business could be developed. I do not know that anything of the kind has ever been attempted." Mr. W. H. Eckert, a veteran telephonist and now president of the Knickerbocker Telephone & Telegraph Company, of New York, also says: "The idea is a new one to me, but I think it is a good one, provided a plan can be devised whereby the company transferring the money will be protected against loss."

One of the most interesting replies received is that from Mr. W. H. Durin, the secretary and treasurer of the Cedar Rapids & Marion Telephone Company, of Cedar Rapids, Iowa, who says: "I have never known of anything of that nature being attempted. I have frequently been called upon by some of our small outside towns to deliver money to some party at our central office. This we have done repeatedly upon being assured by the operator at the rural town that the money had been deposited with them. This money was then sent to the central office, either by draft or check, or was charged as messenger against the call, and was sent together with tolls and messenger collected for the month, at the close of the month. I am confident that if a system of telephone money orders was devised and properly advertised, especially in the large cities, it could be made a very lucrative branch of the business. I am also quite sure that many towns within a radius of 50 miles would adopt this system in payments to wholesale houses in preference to bank drafts."

Senator C. W. Kline, of the Inter-State Telephone & Telegraph Company, of Hazleton, Pa., writes us as follows: "I have not had time to give the matter a great deal of thought, but it strikes me that the system might be very valuable and a great accommodation to the subscribers locally. The only doubt there is in my mind as to the successful carrying out of the matter on a large scale is the fact that the independent telephone system so far is not yet cohesive to a large extent. The consolidated telephone companies of Pennsylvania could cover their territory from Philadelphia to Scranton and Carbondale all right, and they could locally control the matter, and it would be possible to make it work very successfully locally in cities embraced on the system. But if you want to carry it on on the same basis as a telegraph money order system or an express money order system, you would have to have agents in all the territory, which would not be possible for the independents as yet, except as to the territory they embrace. It strikes me this would be of great value to the business public." Mr. C. E. Stinson, general manager of the Rochester (N. Y.) Telephone Company, says: "This is something I have never given any thought to, and, therefore, I am not in a position to give an opinion as to its desirability. I should imagine, however, that a telephone money order system would be very convenient on certain occasions." Mr. C. E. Wilson, of the Keystone Telephone Company, of Philadelphia, says: "I have never heard of any way that money could be transmitted safely by telephone. I do not see how the transaction could be properly checked so as to make the delivery to the right person sure."

The difficulties are also uppermost in the mind of Secretary W. S. Holloway, of the Massillon (Ohio) Telephone Company, who says: "It does seem that we ought to be able to devise some way to handle this business, but I can conceive of no safe way to do it for this reason: Any one who was familiar with the manner of doing business could go in and work a message through just as expertly as the agent. The only way it could be done, absolutely safely, is to have a circuit especially for money order business, with no one but agents of the company having access to it." Mr. C. A. Brown, the well-known telephone patent expert, of Chicago, formerly New York manager for the Western Electric Company, says: "I can see many difficulties in organizing a telephone money order system, and the good to be gained by such a system, I should say from observation, is not worth the effort. Railroads, theaters, steamship lines, dry goods stores, etc., will accommodate patrons by accepting orders given by telephone."

A comparison with the telegraph money order system is instituted by Mr. J. B. Ware, general manager of the People's Telephone Company, of Detroit, and president of the Michigan Independent Telephone Association. In an interesting letter he says: "I know of no case where such a system has been established. There have been numerous instances where, as purly a matter of accommodation, money has been sent by telephone. I recognize that this would be of great advantage in exceptional cases. It is quite difficult, in my judgment, to establish a system which would be reasonably safe for large companies. For small companies such a system could be worked without great danger of loss, owing to intimate acquaintance which the officials have with the various managers and toll operators belonging to the system. I recognize that the expense of sending money by telegraph is very much larger than seems reasonable to those not connected with the telegraph companies. If a telephone money order system can be arranged, which is reasonably safe to the companies, business can be conducted so as to furnish the patrons with such service at rates very much less than now given by the telegraph companies, in my judgment."

One of the most practical communications on the subject is that of Mr. S. M. Strong, superintendent of the Akron (Ohio) People's Telephone Company, who, like Mr. Durin, of Cedar Rapids, Iowa, has actually furnished such service as is proposed. He says: "I beg to state that while manager of a plant in a neighboring city I frequently, as an accommodation to some subscribers who wished to get money to friends in the country at points not reached by telegraph, would telephone to the agent authorizing the payment, and then remit by personal check. In this way the money was delivered immediately. It should be possible to work out a plan by which money could be rapidly transferred and remittances made to the general office the same day. It would, of course, be necessary to have some checking system which would guard against loss, and the money would have to be paid in to the central or branch offices before transmission. A rate double the amount of toll on sums less than $25, and additional charges for larger amounts, would pay a fair revenue and be satisfactory to the sender under ordinary circumstances. In addition to this, the matter of accommodation to the subscriber should be a large factor in deciding the question of advantage."

M. Berthelot's Jubilee.

The jubilee of M. Berthelot's career as a chemist was celebrated November 24 in the grand amphitheater of the Sorbonne at Paris. President Loubet and several members of his cabinet were present to join a great body of savants in doing honor to the great chemist and ex-premier. The eulogies pronounced in his presence were probably very trying to M. Berthelot, who is a man of great modesty, both personally and mentally. As an illustration of the latter trait an American student relates a characteristic incident. During a lecture on electro-chemistry Professor Berthelot was writing some formulas on a blackboard, the significance of which the student failed to catch. In turning toward his class the professor happened to notice the perplexity of the young man as betrayed by his countenance, and stopping his demonstration he went carefully over the work on the blackboard. The results apparently checked, but again noticing the puzzled expression of the student, the professor, much concerned, stepped toward him and asked if he would kindly point out the error he had detected in the work. With the simplicity of mind so often associated with the highest attainments, the great savant assumed that the failure to understand was due to an error on his part rather than to lack of perception on the part of the student.

The Telephone in Texas.

There is probably no State in the Union in which there has been greater development in the matter of building telephone lines and telephone exchanges during the past ten years than has taken place in Texas during that period. There is now hardly a hamlet of a few hundred population that does not have its long-distance telephone connection with the outside world, and in many instances these small places have their own independent exchanges. The building of telephone lines has extended to the remote ranches and towns in the far western part of the State, where there is a sparse and scattered population, and the distance between the several communities is simply enormous. The wealthy ranchmen, however, when they cannot secure connection with some company's lines, put in telephone systems of their own, as they are found to be almost indispensible in the transaction of business. In the thickly settled portions of Northern and Central Texas there is a network of telephone wires connecting the thriving towns and cities.

The Southwestern Telegraph & Telephone Company entered Texas a number of years ago, and its business now extends to almost every part of the State. It has many thousands of miles of long-distance lines in Texas and Arkansas, and at the present time it has no competition of any moment in that branch of the telephone service. It operates large telephone exchanges in Austin, Galveston, San Antonio, Houston, Waco, Dallas, Fort Worth and many towns of smaller sizes scattered throughout the State. During the past two years this company has greatly extended its toll lines, and has made many important improvements to the extensive system in Texas. Its headquarters are at Austin, where it owns a handsome general office and a local exchange building. Colonel E. K. Baker, the general manager of the company, states that plans for the future extensions of the long-distance lines and additional improvements of the system will be carried out as rapidly as possible.

The independent telephone movement has had a remarkable growth in Texas during the past few years. It is conservatively estimated that the aggregate capital stock of the independent telephone companies now operating in that State is not less than $5,000,000. It is a remarkable fact that during the eleven months of the present year the charters of 30 independent telephone companies, having an aggregate capital stock of $1,954,850, have been filed for record in the Secretary of State's office at Austin, Texas. The purpose of each of these companies is to do business in competition with the Southwestern Telegraph & Telephone Company. Two of these independent companies have a capital stock of $500,000 each, and they are both composed of the same interests so far as the holders of the principal stock is concerned. They are the Commercial Telephone Company, which has its principal office at San Antonio, and the Indianola Telephone & Telegraph Company, which has its headquarters at Sherman, Texas. It is understood, however, that the latter company, in addition to operating in North Texas, will also cover the Indian Territory field. Another independent telephone company, which filed its charter in the Secretary of State's office some time last year, and is, therefore, not included in the amount of aggregate capital stock heretofore given, is the Lone Star Telephone Company, which has its principal office at Austin. The principal stockholders in each of these three companies are Ohio capitalists, Mr. C. N. Haskell, of Ottawa, Ohio, being at the head of the respective companies named. In addition to these three large corporations Mr. Haskell and associates are the incorporators of companies of smaller capital stock which are now establishing exchanges at Austin, Temple and many other cities and towns of the State. They are already operating a large exchange at San Antonio, and are expending a vast amount of money in Texas in their long-distance lines and numerous local exchanges. At Austin, where the headquarters of the Lone Star Telephone Company are located, they have purchased and remodeled a large frame building for their general offices and local exchange. The construction work of the Austin, San Antonio and other systems of the so-called Haskell syndicate in that State is of the very best character. Underground conduits are used in all these cities and none but the best material is used in whatever work is done.

The Commercial Telephone Company, of San Antonio, which was incorporated by Mr. C. N. Haskell, of Ottawa, Ohio; Mr. H. M. Aubrey, of San Antonio; Mr. J. E. Boynton, of Waco, and Mr. Z. B. Campbell, of San Antonio, filed an amendment to its original charter in the Secretary of State's office at Austin a few days ago, in which it is provided that it shall do business in 33 counties of that State.

The following is a complete list of the telephone companies which have been organized and chartered under the laws of Texas during the period beginning Jan. 1, 1901, and ending Nov. 25, 1901; also the capital stock of each company and the location of its principal office:

Fayette County Telephone Company, of La Grange, Texas; capital stock, $5,000. Austin City Telephone Company, of Austin, Texas; capital stock, $200,000. Wichita & Charlie Telephone Company, of Wichita Falls, Texas; capital stock, $15,000. Davilla Telephone & Improvement Company, of Davilla, Texas; capital stock, $10,000. Preston Bend Telephone Company, of Preston, Texas; capital stock, $5,000. Southwestern Telephone Company, of Beaumont, Texas; capital stock, $50,000. The Proffitt Telegraph & Telephone Company, of Seymour, Texas; capital stock, $10,000. Grayson County Telephone Company, of Sherman, Texas; capital stock, $150,000. Bell County Telephone Company, of Temple, Texas; capital stock, $12,000. Clarendon Telephone Company, of Clarendon, Texas; capital stock, $3,000. Southern Telephone Company, of Lake Creek, Texas; capital stock, $8,000. Bellah Telephone Company, of Fulda, Texas; capital stock, $2,100. Wichita Falls Telephone Company, of Wichita Falls, Texas; capital stock, $10,000. Richardson Telephone Company, of Richardson, Texas; capital stock, $750. Tyler Telephone Company, of Tyler, Texas; capital stock, $40,000. Texas Telegraph & Telephone Company, of Kemp, Texas; capital stock, $20,000. Beaumont Telephone Company, of Beaumont, Texas; capital stock, $60,000. Brazoria County Telephone Company, of Columbia, Texas; capital stock, $1,000. Alpine-Terlinga Telephone Company, of Alpine, Texas; capital stock, $1,000. Southern Independent Telephone & Telegraph Company, of El Paso, Texas; capital stock, $200,000. Emory Telephone Company, of Emory, Texas; capital stock, $1,000. Goldthwaite & Temple Telephone Company, of Goldthwaite, Texas; capital stock, $25,000. Commercial Telephone Company, of San Antonio, Texas; capital stock, $500,000. Orange Telephone Company, of Orange, Texas; capital stock, $5,000. Indianola Telephone & Telegraph Company, of Sherman, Texas; capital stock, $500,000. Mansfield Telephone Company, of Mansfield, Texas; capital stock, $4,000. Trans-Texas Telephone Company, of Caldwell, Texas; capital stock, $10,000. The Citizens' Telephone Company, of Lone Oak, Texas; capital stock, $4,000. Williamson County Telephone Company, of Taylor, Texas; capital stock, $100,000. Texas Telephone Company, of Wichita Falls, Texas; capital stock, $3,000.

The rates charged by most of these independent companies are much below those of Bell companies.

The Telephone Situation in Michigan.

The city of Grand Rapids, Mich., has been for upwards of five years the main battlefield in the war between the independent telephone interests and the Bell interests, or their successors in the Michigan field, but never has more interest been awakened by the conditions or more attention been riveted upon the situation than at present. Two strong interests have been holding their own in the Michigan field for some time, the Michigan Telephone Company, of which the Erie Telephone & Telegraph Company holds about 37,000 shares, on the one side, and the Citizens' Telephone Company, of Grand Rapids, and its allied interests on the other. The particular interest that centers around the situation at this time grows out of the fact that parties swinging a great deal of local capital have secured an option upon 27,000 shares of the Michigan company stock held by the Erie syndicate, and developments are looked for.

A little more than a month ago Dudley E. Waters, a Grand Rapids capitalist who had held some stock in the Michigan company, terminated successfully some negotiations conducted upon a visit to Boston by securing the option referred to, having interested with him Clay H. Hollister, a banker of Grand Rapids. It appears that it was the purpose of the local capitalists to effect a consolidation of the rival interests, the Michigan company and the Citizens' company. It is known that the Citizens' company received a proposition to purchase the controlling interest in the Michigan company, or the bulk of the shares covered by the option, and declined to do so. An official of the Citizens' company stated a few days ago that there are no negotiations pending, and that the independent company is not ready to buy or sell. However this may be, the option, which was for 30 days, expired Nov. 18, and since that time Mr. Waters has been in Boston for the purpose, it is claimed, of negotiating for another one.

The Michigan company has done a lot of extension and improvement work in the last two years, and claims to have three times the

number of subscribers in the State that it had at the beginning of that period. Toll lines have been extended in all directions, and cables have been laid across the straits to reach the upper peninsula. New exchanges have been built and occupied, and the one in Grand Rapids, a Western Electric Company lamp signal board, is one of the handsomest and most modern in the country. The board in the Detroit exchange, which takes care of 5400 actual subscribers, is said to be the largest continuous telephone switchboard in the country. There are two sub-exchanges in Grand Rapids, and the latest directory shows more than 4200 subscribers. These improvements, of course, have been expensive, and it is understood that the Michigan company is at present laboring under a heavy indebtedness. It is claimed that the indebtedness exceeds $7,000,000, and that the interest account of the company aggregates $370,000. The current rates in Grand Rapids for Michigan telephones at present are $24 for business houses and $12 for residences. The independent interests hold that under the contracts the Michigan company has for the use of the Bell apparatus no money can be made at these rates, but, of course, this is disputed by Michigan company officials.

The Citizens' company commenced doing business in July, 1896, with 400 telephones, although it had 1,600 subscribers listed at the time, but no toll line service. At present it has 3800 telephones in exchange service, and connections with 24,050 State line telephones. Dozens of new exchanges have been built and equipped, other independent companies have been absorbed and the service has been made to cover the State. The toll-line service has been improved and extended until it now reaches every town of any importance in the lower peninsula of the State and several points in Indiana and Ohio. In the past 12 months $175,000 has been devoted to expansion in this direction.

The People's Telephone Company, of Detroit, will be doing business within the next year, it is promised. Already 5000 subscribers there have been secured. This enterprise was largely promoted by one of the directors of the Citizens' company, and is backed by the Everett-Moore syndicate, which holds $1,750,000 of the $2,500,000 of stock in the new company. The Everett-Moore people control the new toll line between Lansing, Jackson, Adrian and Toledo, which, under a recent 25-year contract arrangement, throws the Michigan independent interests in connection with the entire independent system throughout Ohio.

The future is considered full of promise for the independent telephone interests in Michigan, and those who are in touch with the situation do not believe Mr. Water's option on the Michigan company will have any direct effect upon the independent situation. Officials of the Michigan company are fully as sanguine and hopeful as to the future, however, and point to the improvements that have been made in the last two years, and that are now under way, as an evidence of the faith the company has in the business.

Telephonic Identification of Cats.

The following story is told gravely by the *Chicago Tribune:* There was a banquet in Chicago not long ago to which one of the guests, a lawyer, had taken his office cat, a feline being the emblem of the organization that gave the dinner. The banquet was given in the Great Northern Hotel, where the cat the lawyer had taken to the dinner became lost. The next day the lawyer called up the hotel on the telephone, and asked if they had his cat yet. He was told that the bell boys had hunted all around among the cats kept as rat-catchers in the hotel, and that they had finally selected four cats, one of which they felt sure belonged to the lawyer.

"Well," said the lawyer, "I haven't time to come over and pick my cat out. Just hold those animals one by one up to the telephone transmitter and pinch their tails and make them yowl."

One of the bell boys dutifully held up the cats to the telephone, and made each one of the felines give a good, resounding wail. The lawyer dismissed each cat until the third cat was put up to the instrument. It gave one yowl, when the lawyer enthusiastically exclaimed:

"Yes, all right; that's my cat. I know that voice. Send her over right away." So the cat was sent over to the lawyer's office and turned out to be his missing pussy.

Annual New York Meeting of the American Society of Mechanical Engineers.

The annual New York meeting of the American Society of Mechanical Engineers was held at the headquarters of the Society, 12 West Thirty-first Street, Dec. 3 to 6, at which a large budget of papers was read and a number of topics discussed. The only paper relating directly to electrical engineering was one read by Mr. W. C. Johnson on the water power development at Hannawa Falls on the Raquette River, near Potsdam, N. Y. A fall of 85 ft. was developed by building a dam at the village of Hannawa Falls, whereby a pond 2½ miles long, and covering about 200 acres, was formed. From this pond the water is conducted by a canal about 2700 ft. long to a forebay, and thence by penstocks to the wheels. The tail-race extends about 2000 ft. down from the power house. The paper describes in great detail the features of the hydraulic development.

Provision is made for four 1250-hp Leffel waterwheels, to each of which will be direct connected two 350-kw, three-phase, 440-volt generators. At present but one of these sets is installed. The generators are of the revolving field type and have 24 poles, the frequency of the current supplied being 60 cycles. At present there is a double line to Pottsdam, each line consisting of three cables of seven strands each, of No. 10 aluminum wire. The length of the line is 3½ miles, and it is calculated to transmit 375 kilowatts with a drop of 400 volts, thus delivering 4000 volts at Pottsdam. It is intended to lay a 20,000-volt line to the village of Colton, 10½ miles from the station. Part of the power house is occupied by a ground wood pulp mill, the machinery of which, however, is not run electrically but by a rope drive.

In a paper by Mr. C. W. Hunt entitled "Working Loads for Manila Rope," are given several tables based upon experiments with manila ropes, one of which refers to tests with spliced and knotted ropes. All the ordinary cases involving the use of manila rope are covered by the data given in the tables. The principal table gives the working load for different diameters of rope from 1 to 1¾ inches for three gradations of speed as follows: For derrick, crane and quarry work, at speeds from 50 to 100 ft. per minute; for wharf and cargo hoisting, at speeds from 150 to 300 ft. per minute; for rapid hoisting, or speeds from 400 to 800 ft. per minute. The table also gives the medium diameter of sheaves for the different sizes of ropes and speeds.

Mr. J. O. Nixon in a paper describes the Renold silent chain gear which has been designed to obviate objections applying to ordinary sprocket gears. This gear consists of a chain composed of links of a peculiar form, either stamped from a sheet or cut from a drawn bar, and fastened together by shoulder rivets into a chain of any desired width running over cut sprocket wheels with teeth of a shape varying with the size of the wheel. It is stated that this gear is absolutely silent, and may be run at high speeds, and that it is capable of transmitting any amount of power from the smallest to the greatest. In summing up, 17 advantages over other forms of gear are assigned to the one described. Among these advantages are a positive speed ratio, there being no slip; there is no tension in the slack side of the chain, and, therefore, a minimized loss in journal application; it is adaptable to short way on centers and to hot or damp situations; the gear is silent and may be run at high speeds; the initial perfect action is preserved throughout the life of the chain; the load is distributed over all teeth in the machine; it does not require fixed centers; there is no sliding friction on the teeth.

Mr. Albert Kingsbury gave an account of some experiments on the effect of clearance on the economy of a small steam engine. The engine was a horizontal plain slide valve 5 1-6 by 7-inch engine controlled by a shaft governor. Variations in the clearance volume were made by inserting cast-iron rings under the back cylinder head. In testing, the engine was made single-acting by blocking the valve ports at one end. The clearance was varied from 10.82 to 32.5 per cent. The results showed a regular but not great increase in the water rate with increase of clearance. The unsatisfactory conclusion is arrived at, however, that as the increase of clearance was accompanied by an increase in the pressure, corresponding to less complete expansion at release, and also by a decrease in the pressure at the end of compression, the increase in the water rate can only be regarded as a joint effect of increased clearance with decreased expansion and decreased compression.

Professor C. H. Benjamin, of Cleveland, Ohio, gave an account of bursting small cast-iron flywheels. Sixteen wheels, each 24

inches in diameter, were tested, the weights varying from 60 to 123 lbs. The conclusions of the paper are that for wheels of moderate size correctly proportioned, a solid rim is by far the safest form, and will require a speed of 350 to 400 ft. per second to produce rupture. Jointing the arms at the rim and bracing the rim by internal webs have no important effect on strength. Joints in the rims are the principal source of weakness, especially if located between the arms. Hollow rims will permit of a much more efficient joint. The best results were obtained from the type of flywheel devised by Professor Archibald Sharp, of London, Eng., which consists of a cast-iron rim with spokes of steel wire secured tangentially to the hub; by the tightening up the nuts at the rim securing the ends of the wire spokes, the hub is accurately centered.

Professor Benjamin and Mr. Roy A. French gave the result of some experiments with spiral springs. The paper gives a formula for the calculation of such springs, and a table of data for substitution in the formula.

Mr. H. L. Gant described a bonus system of awarding labor, being a system of task work with instruction cards and a bonus. The system is described in minute detail and different forms of cards are reproduced. A card handed with a job to a workman itemizes all the different operations, opposite each of which is designated the time which the operation should take. For example, in the case of lathe work, the items are as follows: The numeral referring to the number of minutes: Chuck, 2.5; fuse end, 4; turn half-way, 12; turn end for end, 5; turn half-way, 12; face end, 4; remove from machine, 2.5. The total is 42 minutes, and should the workman do the job in less than this time he is paid a bonus.

Mr. F. B. Cory described a portable accelerometer for railway testing. The instrument consists of a heavy base having a horizontal cavity, at each end on which is a short vertical glass tube. When the cavity and part of the tube is filled with mercury an accelerating motion will produce a difference of level in the vertical columns, which difference of level will indicate the rate of acceleration.

Mr. Ernest W. Naylor described a new valve gçar for gas, steam and air engines. Poppet valves placed in the cylinder head are used, both for steam and exhaust. The valves are operated by electromagnets through the intermediary of a link motion.

Mr. Fred A. Scheffler described a new type of separator and superheater, which consists of a series of wire meshes or screens placed between rings of cast iron, a number of the rings with attached meshings being bolted together with headers to form a separator. The theory of the apparatus is that the small globules of water entrained by the steam are broken up by the first piece of mesh, which action is continued through each successive layer until it is so completely atomized upon reaching the outlet chamber or header that it flashes into dry steam upon the addition of a small quantity of heat, which heat is obtained by the wire drawing due to the steam and water passing through the screens. There are generally from 25 to 30 layers of the mesh and the reduction of the pressure is about 1 per cent, the temperature of the steam being increased proportionately to this reduction.

Mr. F. F. Nichol suggested a new decimal system of measurements, which he called the "Linvolpon system." The suggestion is to adopt ⅛ inch as a basis, 10 of which shall constitute the unit, for which he suggests the name of "Lin." Prefixes used in the metric system would indicate multiples and sub-multiples of this unit. The advantage claimed for this extraordinary system is that it would not necessitate a change of our sizes, but only the names and figures.

Professor F. R. Hutton advanced as a topic of discussion the cost to run trains at high speed. One authority is quoted to the effect that an increase of speed from 40 to 60 miles an hour would raise the fuel consumption by 52½ per cent. Professor Goss says that taking the hours as the unit the increase of power is 225 per cent. Another quotation is that for an increase of speed by 53 per cent there is an increase in coal consumption of 92 per cent. The statement is mentioned that while the cost of running ordinary trains is $1 a train-mile, that of running limited trains is nearly $2.

French Telephone Rates.

A cable dispatch from Paris of Nov. 30 says: The Minister of Posts and Telegraphs, M. Millerand, announces a general reduction in the price of telephone service throughout France. In Paris the rates are reduced from $80 to $60 a year from January. Another reform is the reducing of the charge for pneumatic-transmitted messages—the "petit bleu"—from 10 to 6 cents.

Standardization of Engines and Dynamos.

At the annual New York meeting of the American Society of Mechanical Engineers, held this week, the committee on Standardization of Engines and Dynamos submitted their final report, which covers ten principal points. The report considers only direct-current generators, and these only up to 200 kilowatts capacity. The observations of the committee included in the report are summarized below:

Size of Units.—The endeavor of the committee has been to reduce the number of standard units to the fewest sizes. This will commend itself to all manufacturers as tending to reduce the great number of patterns required to be kept on hand.

Revolutions.—The standard speeds have been chosen after careful deliberation and investigation of the practice of all the engine and generator builders in the country. Permissible variation of speed of 5 per cent above or below the mean speed is provided; an examination of the practice of all the engine and generator builders shows that this covers practically all the machines which may be considered as a standard make at the present time, and assurance has been received from some builders whose conditions differ somewhat that if there is a general agreement upon the scheme outlined, they will be prepared to change their machinery to conform to the recommendations.

Shaft Diameters.—These are the result of careful analysis of the existing practice of all manufacturers and a consideration of all the conditions affecting the diameter of the shaft. The preliminary report which was sent out to the manufacturers elicited only a few adverse criticisms, and these, after correspondence, were withdrawn. In order that the reason for the diameters of shafts recommended shall be thoroughly understood, it is explained that (especially in shafts for side-crank engines) the permissible deflection has determined the diameter. This, in some cases, is larger than would have been necessary for torsion and bending where deflection did not have to be considered. As cases sometimes arise where cross-compound engines or double engines are connected to generators coming within the recommendation, and as such units require considerably larger shafts than those given the tables, it is stated, that the recommendations apply only to engines of usual proportions, with the generator attached at the side of instead of between the cranks.

Length of Generator Along the Shaft.—When it came to investigating the question of length along the shaft (between limit lines) to be provided for the generators, it was found that the practice of manufacturers required provision for two classes, which may be called "long" and "short" generators. It would have been much better to provide for but a single class, with a small allowance for variation, but there is such a marked difference in the lengths for the same power that it was deemed best to make provision for these two classes, so that the engine builders can govern themselves accordingly. It will be noticed that the maximum difference in lengths between the two classes is six inches, which in the small sizes is reduced to five inches. In the case where an engine is to be provided for a generator which falls into the "long" class, but which is only a little over the limit for the "short" class, or one which is considerably less than the maximum of the "short" class, the excess clearance is to be provided for on the side next to the engine; that is to say, the side away from the commutator. The fact was carefully considered that for these varying lengths of generator and shaft the engine builder has to provide different lengths of sub-base, and in order to reduce the expense of patterns here to a minimum, the idea is that these patterns would be made so that the end away from the commutator can be extended the necessary amount, five or six inches, to take care of the increased length of bed. Obviously, this means simply a standard pattern with a standard adjustable end for each unit.

Height of Shaft.—There are two classes of generators to be provided for under this head. Those which are split vertically and those which are split horizontally. The former have a flat base which rests directly upon the flat top of the sub-base, while the latter have feet which take the weight of the generator. In order to arrange that the engine builders' patterns may be reduced to a minimum and still may be stock patterns, which will fit every style of machine, dimensions have been chosen for height of axis of shaft above top of sub-base sufficient to allow for the vertically-split machines, and also, except as stated later, to clear the periphery of the horizontally-split machines. The scheme provides for a main pattern to which patterns for the stools and seatings for both horizontally and vertically-

split generators can be attached before the pattern is sent to the foundry—stools for the horizontally-split machines and rectangular seatings for the vertically-split machines. In the case of the 150 and 200-kw units, a recess is provided for in the top of sub-base to allow the lower part of some horizontally-split generator frames to be accommodated, and so to avoid unduly raising the center of the shaft. In the case of the vertically-split machines and those which are split horizontally and do not need this recess, the top of the sub-base will be flat and continuous.

Width of Top of Sub-Base.—This has been decided by careful examination of existing practice, and the figures recommended will cover the necessities for all sizes of generators.

Armature Fit.—The matter of armature fit received very careful consideration and the recommendation is for what is known as a single fit. The opinions were obtained of manufacturers in respect to the allowance to be made for a pressed fit, and find that allowances of .001 inch for shafts 4 inches to 6 inches, inclusive, and .002 inch for shafts 6½ inches to 11 inches, inclusive, represent the best existing practice. The armature bore is to be the *exact* size given in the table, and the allowance is to be made by the increase of diameter of engine shaft. In order to secure the best results, it will be necessary to work to a definite gauge; to this end it is recommended that the generator builder furnish a gauge the *exact* diameter of the bore and the engine builder make the necessary allowance for the pressed fit, as recommended. This will avoid uncertainty as to the responsibility for the fit.

Overload Capacity of Engines and Generators.—Generator builders are frequently called upon to provide, during short periods, for overloads of as much as 50 per cent, and, in occasional cases, of even 100 per cent. It is evident to every engine builder that to provide an engine large enough to drive the generator under such extreme overload capacities, gives an unreasonably large engine for the rated load, and seriously interferes with the economy with which the power is produced. Bearing in mind that the recommendations are entirely for standard practice, it is recommended that the standard overload rating of any direct-connected unit should not, in any case, exceed 25 per cent of the rated capacity. Under these conditions of overload the economy of the unit should not be expected to be as high as when operated at the rated load. If, under peculiar conditions, a higher overload capacity is demanded, it must be understood that this is a special case not covered by the standard machines, and provision must accordingly be made for meeting this demand.

Brush Holders.—It is recommended that the brush holder rigging shall be supported upon the generator frame. This will commend itself, as it makes the electrical part of the outfit entirely self-contained.

Holding-down Bolts, Keys and Outbound Bearings.—It is recommended that the holding-down bolts, shaft keys for securing the generator hub to the shaft, and the outboard bearings should be furnished by the engine builders. This is in accord with almost universal practice at the present time. The recommendations in these particulars do not cover matters of so great importance as some others; but, if adopted, they will tend to settle certain points about which there has occasionally been dispute and considerable controversy in correspondence. In the table will be found columns showing sizes of shaft keys; also the number and size of holding-down bolts. No lengths are given for keys, as such differences of opinion existed in respect to proper length, that it was thought best to leave

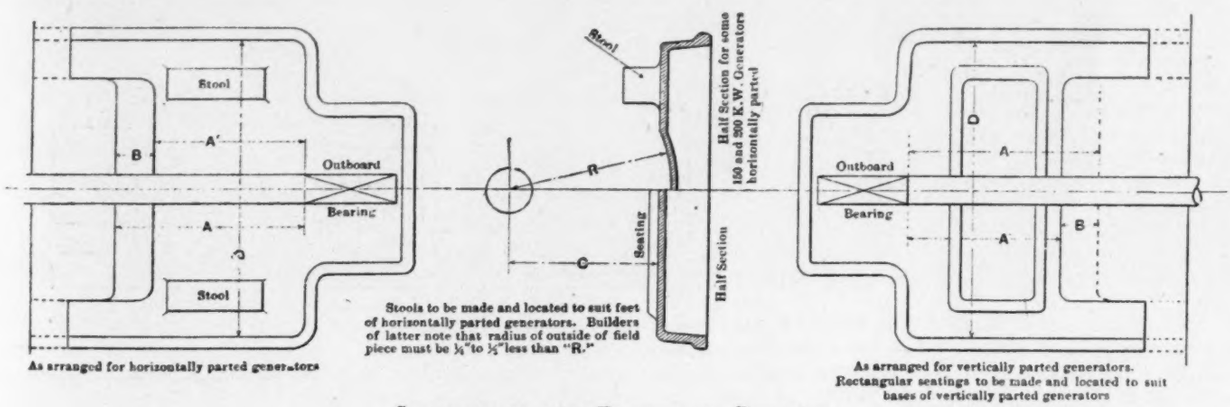
TABLE OF SIZES, SPEEDS AND STANDARDIZED DIMENSIONS OF DIRECT-CONNECTED GENERATING SETS.

(To accompany Diagram.)

Capacity of Unit, Kilowatts.	Revolutions per Minute.	Armature Bore		Diameter of Engine Shaft at Armature Fit.		Space Occupied on Shaft between the Limit Lines		*B*, Length of Extension Pieces, Inches.	*C*, Height of Axis of Shaft above Top of Base, Inches.	*R*, Inches.	*D*, Width of Top of Sub-Base. Inches.	Key (a Feather).				Holding-down Bolts	
		Center Crank Engines, Inches.	Side Crank Engines, Inches.	Centre Crank Engines, Inches.	Side Crank Engines, Inches.	Long Class *A*, Inches.	Short Class *A'*, Inches.					Width, Inches.	Thickness, Inches.	Depth in Shaft at Edge, Inches.	Projection above Shaft at Edge, Inches.	Diameter, Inches.	Number.
25	310	4	4½	4 + 1/1000	4½ + 1/1000	30	25	5	23½	Flat.	48	1	¾	⅜	⅜		4
35	300	4	5½	4 + 1/1000	5½ + 1/1000	33	28	5	25	Flat.	54	1	¾	⅜	⅜	1	4
50	290	4½	6½	4½ + 1/1000	6½ + 2/1000	37	31	6	28	Flat.	60	1¼	¾	⅜	⅜	1	4
75	275	5½	7½	5½ + 1/1000	7½ + 2/1000	43	37	6	31	Flat.	66	1½	1	½	½	1¼	4
100	260	6	8½	6 + 1/1000	8½ + 2/1000	48	42	6	34	Flat.	72	1½	1	½	½	1¼	4
150	225	7	10	7 + 2/1000	10 + 2/1000	51	45	6	37¾	41¼	84	1¾	1¼	⅝	⅝	1¼	4
200	200	8	11	8 + 2/1000	11 + 2/1000	54	48	6	42¾	47½	96	2	1¼	⅝	⅝	1½	4

NOTE 1.—Five per cent. variation of speed permissible above and below speeds in table.

NOTE 2.—Distance from center of shaft to top of base of outboard bearing may be less than *C* (to suit engine builder), though not less than possible outside radius of armature.


Stool
B
A'
Outboard
Bearing
A
Stool
As arranged for horizontally parted generators
Stool
R
Seating
C
Half Section for some 150 and 200 K.W. Generators horizontally parted
Half Section
Stools to be made and located to suit feet of horizontally parted generators. Builders of latter note that radius of outside of field piece must be ¼" to ½" less than "R."
D
A
Outboard
Bearing
A
B
As arranged for vertically parted generators. Rectangular seatings to be made and located to suit bases of vertically parted generators

STANDARDIZATION OF ENGINES AND DYNAMOS.

the determination of the length of key for adjustment by engine and generator builders in each individual case. Sizes of keys have been taken so that standard rolled stock can be employed. It is recommended that the keys be made straight and be used as feathers. They should, therefore, fit accurately on the edges and not on the top. Proper allowance should be made in cutting the keyway in the armature hub, so that there will be sufficient clearance at the top of the key.

In conclusion, the report states that in the course of the investigations of the committee attention was called to a number of points which, from their nature, are not exactly in the same category as those on which recommendations are made, yet are of such importance that they are offered as suggestions for consideration by members of the society, with a view to their adoption if considered sufficiently meritorious. The points are as follows:

With regard to pressing armature on shaft, usually the contract definitely provides by whom this is to be done, but it is suggested that if there is no such provision in the contract, it should be understood that the engine and generator builders shall agree who is to do this work, so as to avoid any dispute when the separate portions of the unit are delivered on the premises.

For convenience in operation and for the information of engine and generator builders, it is suggested that for units up to 75 kilowatts, inclusive, the floor line should come at the bottom of the sub-base; and for units 100 kilowatts to 200 kilowatts, inclusive, the floor line should be 1 inch below the rough top of the sub-base.

In view of the fact that in some cases the distance between bearing and commutator is very small, it is well for engine builders to bear in mind that provision should be made to prevent oil from the bearing getting on the commutator.

Some generator builders have asked that the end of the shaft be drilled and tapped to facilitate, if necessary, the removal or placing of the armature on the shaft at the place of erection; we suggest that this be done.

In some cases generator builders require special nuts, bolts or fixtures for attaching generators to the shaft. Under these conditions it is suggested that the generator builders should furnish all attachments to their apparatus that are not already specified in the report.

The Faller Automatic Telephone Exchange.

An automatic telephone system which marks a decided departure in this branch of telephony was the subject of a patent granted Nov. 19 to Ernest A. Faller, of Baltimore. One striking feature of originality is that instead of providing contacts representing a multiple of all the lines in the exchange at each selector, which so far have formed a necessary feature of automatic exchanges, the inventor provides sets of connecting rods which practically correspond to the connecting cords of an ordinary exchange. In the operation of the system the movable carriage that forms the terminal of the subscriber's line first connects itself to a pair of these rods, this operation corresponding to the insertion of the answering plug into the answering jack; and then the selector comes into play and connects the pair of rods to the carriage terminal of the line wanted, corresponding to the insertion of the connecting plug into the multiple jack. Here, however, there are no multiple jacks. Each subscriber's line has only one terminal, and the selective mechanism first connects the calling line to an unoccupied pair of rods and then connects the line called for to the same pair of rods, the connection remaining locked until a release signal is sent.

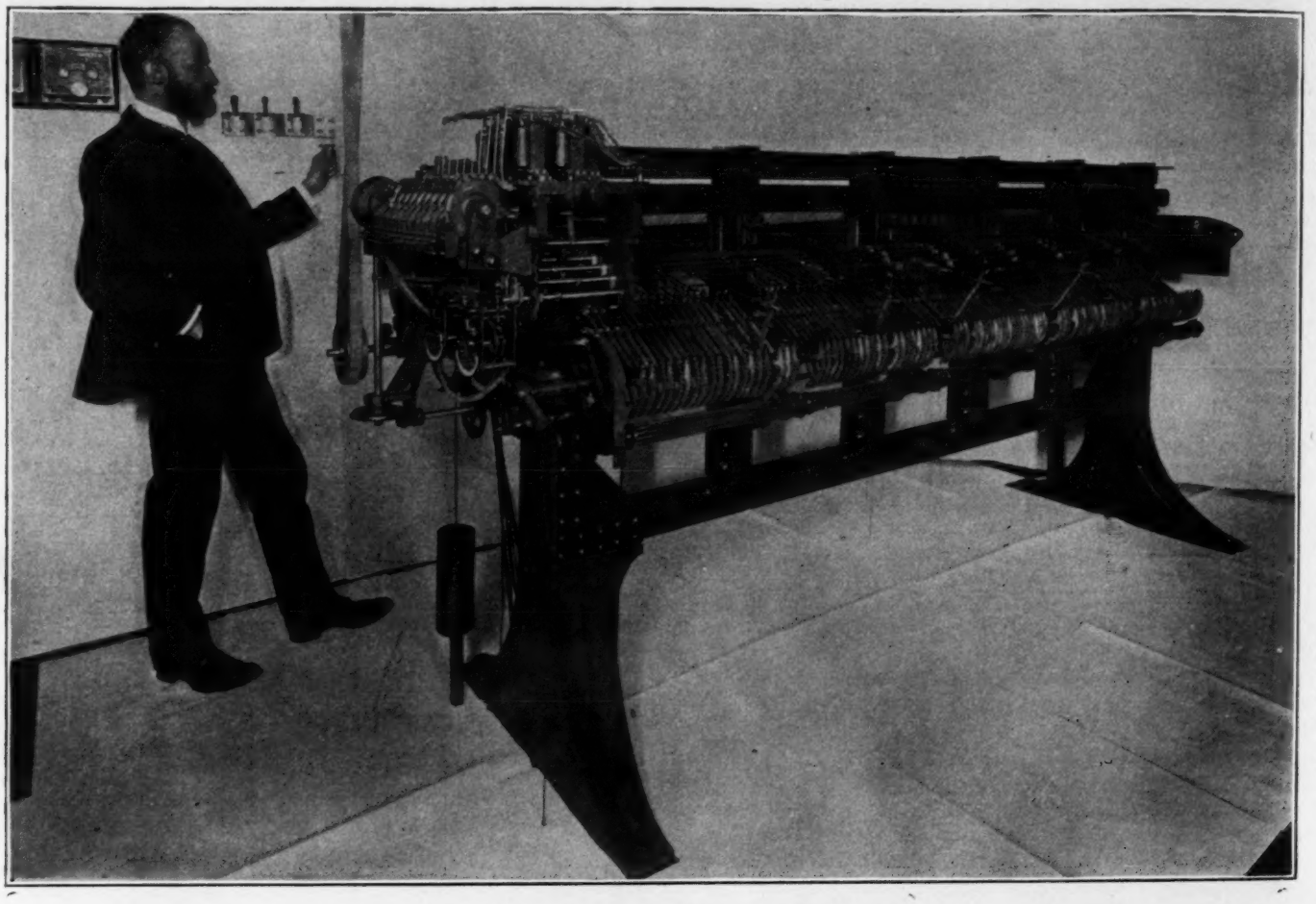


FIG. 1.—FALLER AUTOMATIC TELEPHONE EXCHANGE.

Automatic means are provided for preventing interference with an established connection and for causing the carriage to take up the first unoccupied pair of rods, and also for returning the carriage to the normal position if no unoccupied pair of rods is available when a call is made, though Mr. Faller considers that this last condition would never arise in practice with an equipment of connecting rods equal to 10 per cent of the number of lines. The system is adapted to be used with common battery transmission. When a connection is established an automatic ring is given on both bells. In what follows the operation is explained in detail.

Fig. 1 shows a 100-line exchange recently completed, and Fig. 2 gives diagrams of connections. This machine illustrated contains a total of 15 electromagnets, 10 of which are clearing-out magnets embraced in the cord circuits. These magnets are visible at the extreme left, i. e., on top of the machine. In no case are electromagnets called upon to do mechanical work, the switching act being performed by power-controlled mechanical devices, dependent in their function

upon controlling magnets. These are partly operated from the subscribers' station, and partly in local circuits. Two more magnets control a selector, two more the operating gear, and one a busy test. These latter are not visible in the illustration.

The power or operating gear is partly visible at the left, it being driven by the belt shown. This power device is common to all the incoming lines, and goes through a fixed cycle of operations for each switch made.

The individual lines terminate in carriages, not visible in the cut. These carriages are adapted to travel under a series of metallic bars, forming the terminals of what would in manual practice be cord-circuits. They carry springs in which the lines terminate, and which are adapted to make contact, with the before-mentioned bars. The toothed sectors for operating the carriages are shown in the illustration, which shows all of them in position of rest except two pairs, one pair of which is shown connected or in talking position, and the other in the act of switching.

Motion is imparted to these sectors by a long lantern pinion. All idle sectors are held out of engagement with this pinion by a lever controlled by a busy wheel. The busy wheel performs the office of individual line drops or indicators, and makes it possible to dispense with individual magnets in the subscribers' lines. The construction adopted makes it impossible to release more than one lever at a time, and consequently prevents all confusion which would otherwise arise from simultaneous calls. As it is, such calls would be handled by the machine in a certain numerical rotation; no calls are lost, no matter how many should be made at exactly one and the same time. This is accomplished through the peculiar arrangement of circuits to be described later. Generally speaking, the operation is as follows:

Normally, all subscribers' circuits are free from ground, and the high resistance ringer is permanently bridged across the metallic circuit. The subscribers' calling device, or sender, is normally open, both as to ground and metallic circuit. The line terminal switch or carriage at the exchange, when in position of rest, causes one of the subscribers' line terminal springs to make contact with what is termed a ground spring. This spring is connected to one of a circle of commutator bars or pins, swept over by a brush.

There are as many sections in the commutator as there are subscribers. The brush is connected through a moving contact with a battery, and an operating magnet from which a line leads to ground The brush is mounted on the busy wheel shaft, and partakes of its rotation. The mechanical interconnection of parts is such that upon the energizing of the magnet mentioned the busy wheel is stopped and the operating gear started. When the operating gear has gone through its cycle, then the busy wheel is again started and will continue to run until the magnet becomes energized again.

At the subscribers' station the before-mentioned sender is bridged onto the circuit and also to the ground. This sender is shown to the extreme left of the illustration, and contains a clockwork which, when started, sends a varying series of electrical impulses over both legs of the metallic circuit simultaneously, using the ground for a return. It also contains a magnet, whose armature normally retains the clockwork until it is energized by current from the exchange. The number of impulses sent corresponds to a number displayed through a window. The subscriber may vary the number wanted, at will, by turning the knobs operating the number dials.

To protect both circuit and exchange against abuse, certain protective devices keep all accessible parts of the sender locked, during the sending of a signal. A sender is shown in upper left hand corner of cut. To call, the subscriber sets his number disks, so that the number he wants appears in the window, and then he turns a button. This is all the operation necessary on his part to cause a switch to be made.

When the switch is completed, he as well as the subscriber called receives a bell signal. They then proceed by taking off their receivers and begin conversation. If the calling subscriber does not receive any bell signal, it means that the line he wants is busy, and he may make other calls, or repeat the first one after a while. When the calling subscriber turned the button mentioned, he caused the sender to ground both legs of the metallic circuit. This caused (through the ground spring) one of the commutator bars or pins mentioned, to become grounded, and, consequently, as soon as the traveling brush reaches that pin a circuit will be established. This circuit includes the operating magnet which, on becoming energized, stops the traveling brush, and starts the operating gear. This in turn drops the calling subscriber's shuttle or sector into engagement with the long lantern pinion shown, and the attached carriage is carried to a point where its terminal springs make contact with a pair of so-called power bars.

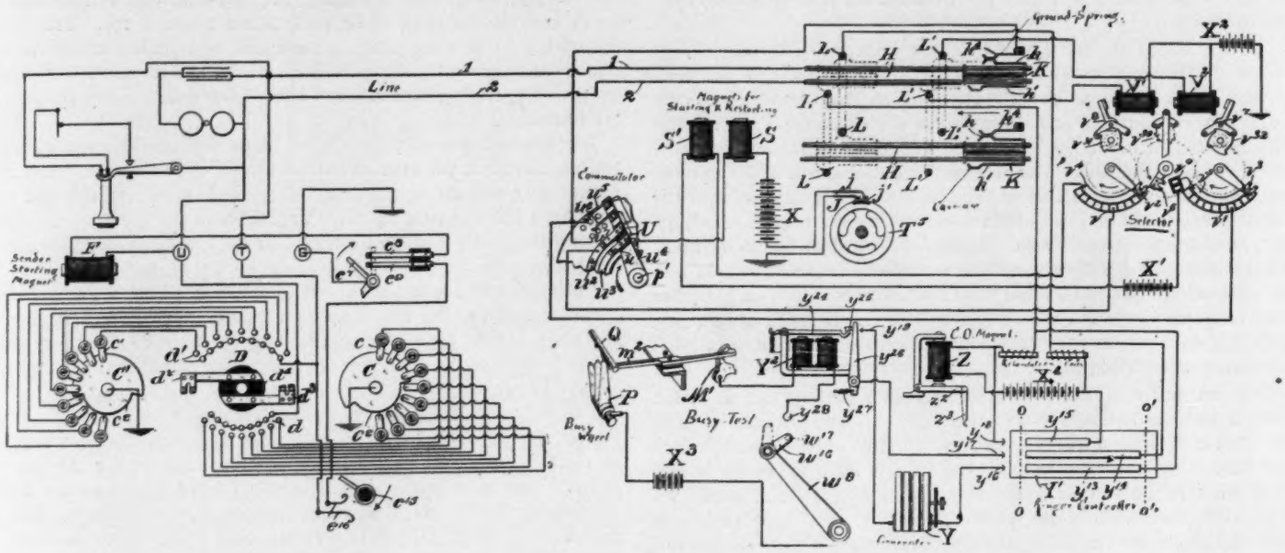


FIG. 2.—DIAGRAM OF CIRCUITS, FALLER AUTOMATIC EXCHANGE.

These power-bars are connected to a pair of magnets controlling a selector, and then to a battery and ground. Current from the battery is consequently sent over both legs of the metallic circuit, with the effect of releasing the sender, which then sends a series of impulses, actuating the selector magnets a given number of times, corresponding with the number to which the sender is set. For details of connection see Fig. 2.

The selector then establishes a local circuit, including a commutator and brush, concentric with the first-mentioned commutator, and the result is that the shuttle of the subscriber wanted is also dropped into the pinion shown. The operating gear then rotates the pinion through a greater or less arc, corresponding with the number of circuits then already established. Immediately afterwards, a rocking lever located behind the pinion, engages a certain tooth of the shuttles, and lifting the pair of shuttles off the pinion raises them far enough to enable their hooked heads to engage a shuttle detent. There are as many of these detents as there are talking circuits, in the case of this machine ten. This corresponds to the usage followed in manual boards, but the ratio can be increased or decreased at will.

As soon as the pair of shuttles are hooked to the detent the circuit is established. The machine then throws a generator on to the circuit, ringing both calling and called subscribers' bells. A timing device controls the length of this signal, which can be varied to meet

different requirements. Upon the subscriber taking off his receiver the clearing-out magnet keeps the switch from clearing out, when the receivers are again hung up, the clearing-out magnet becomes de-energized, and its armature causes the shuttles connected to return to their position of rest.

Referring to the diagram of circuits it will be seen that it does not differ materially from the arrangement of circuits of a manual board; the talking circuit is almost identical, and only the calling and operating circuits are added.

Strange to say, the use of cord circuits in automatic telephone exchanges has apparently never before been attempted, though in manual practice they have driven any other construction out of the field. This was so much the case that the patent on this invention, recently issued, is claimed to broadly cover the use of cord circuits or their equivalents in automatic telephone exchange practice. It is also claimed that no other arrangement is possible whereby simplicity of circuit can be preserved, since it has been considerations of just this character which have led to the universal adoption of the cord and plug arrangement in manual boards. The inventor considers that indifferent results with automatic systems in installations of any size have in the past been due to the fact that the complication of wires and contacts did not keep in proportion with the number of lines handled, but rather increased in a geometrical ratio. This system, even in small units, has less magnets, contacts and connections than a manual board of the same capacity, and the larger the board the greater becomes the contrast between this automatic and the manual.

Another important feature of this new system is a testing device, which constantly tests the subscribers' lines in rotation for both ground, short and open circuit. As soon as any trouble occurs on any one particular line or its instrument the exchange automatically notifies the man in charge of trouble, who can at once on the board detect the disabled line. The rest of the board is not at all affected and remains working, but should the trouble on the line continue the trouble device will at intervals keep on calling the trouble man's attention to the fault until it is remedied. Each line, unless engaged, is subjected to this test once every five seconds, so it will be seen that the protection against disabled instruments is carried much farther than in manual practice, where generally a test is made once a day. This test does not in any way disturb the subscriber; in fact, he is not aware of its being made.

The possibility of the subscriber's senders getting out of order, though remote, has also been taken care of, and in case of such trouble the subscriber has only to press a button on the sender, which will invariably connect him with the trouble man, to whom he can state what is the trouble. He can also, in like manner, obtain information, such as new subscribers' numbers, etc. Line resistance does not affect the station in any way, since the currents on the line do not have to perform any mechanical work at all. Consequently, weak currents can be employed. There is not a single contact in the exchange made by electromagnets. Every contact is established and broken by power, and thus every one can be amply proportioned and made and broken positively. No cord or flexible conductor whatever is used throughout the exchange. There is not, and need not be, any crowding of parts, or any delicate parts, as the limitations of an operator's reach do not obtain with a machine.

The carriages in the machine shown are set on ⅞-inch centers, giving them ample room. As to actual space occupied, the machine will compare favorably with present manual boards, and if it is considered that it can be located irrespective of conditions of light, ventilation, etc., the comparison becomes immensely more favorable still, it is said.

As before stated, the machine shown and described serves 100 lines, but the system was evolved with a view to handle large exchanges and work is now in progress upon the individual sections of an exchange to ultimately accommodate 10,000 subscribers. This will be a trunked or transfer-board, consisting of a number of sections of 100-line capacity each, and two sets of pilot or transfer boards effecting the trunking. Unlike the present multiple board, an addition of sections will not in any way affect the sections installed, or necessitate additional taps into said sections.

Generally speaking, the cord circuits as described are developed into trunk lines leading to a pilot. Other trunks lead from this pilot to other pilots, and from them still other trunks to the individual sections again. Any one circuit of a 10,000-wire exchange is, consequently, built up of the calling and called line and three trunks. It is immaterial whether the entire equipment of the station is concentrated in one place, and in most cases it will be more desirable to have substations scattered over the territory served, as only a fraction of the line total need then be carried from station to station, in no case more than 11 per cent. This is the highest figure of lines ever found in any part of the interconnecting wires of the trunked exchange. The time necessary to make a connection in the exchange is said not to exceed 10 seconds, and with various improvements now contemplated it is expected to be considerably lowered.

No matter what the size of the exchange, a perfectly balanced, metallic circuit will always be obtained, having absolutely no taps or multipled branches anywhere. Simplicity of operation by the subscriber is fully preserved. The subscriber only sets the number wanted, and turns a button. This accomplished, all future operations are performed entirely independent of him. He is notified by his ringer when the switch is made, and then proceeds in the ordinary way by taking down his receiver and beginning the conversation. Hanging up the receiver clears out the connection.

The general method of trunking followed in this large exchange bears a great similarity to that of the so-called limited express system of Sabin & Hampton. A large exchange of that character has been in operation for a number of years in San Francisco, and gives universal satisfaction.

As to simplicity of installation, a few figures may not be out of place. Each section of a 10,000-line board can be completely wired at the factory, so that in installing only 100-line connections and 22 trunk connections need to be made per section of 100. This is all the wiring to be done when the machine is installed outside of the central battery and generator connections, which number 8 in all. Only two operating batteries are needed, no matter what the size of the exchange.

The current consumption is less than with the present multiple boards, as only 1 per cent of the circuits of the exchange, when idle, receive any current at all, and then less than .02 ampere, and that only for a fraction of a second. Variations in the speed of the motor driving the machine do not affect it, as no synchronizing principle is employed.

Automatic means are provided to indicate stoppage of power or current supply, as are also means for instantaneously transferring all the lines served by a section that may become disabled, or which needs inspection, to a reserve one, of which a sufficient number will always be provided in large exchanges.

The inventor is Ernest A. Faller, a native of Guetenbach, Black Forest, South Germany. He is 31 years old, and has been engaged in electrical pursuits on both sides of the Atlantic for the last ten years. The invention is owned in the United States by the Faller Automatic Telephone Exchange Company ,of Baltimore, Md., of which Dr. J. W. Chisholm is president and E. A. Faller secretary.

Some Applications of "Electro-Osmose."

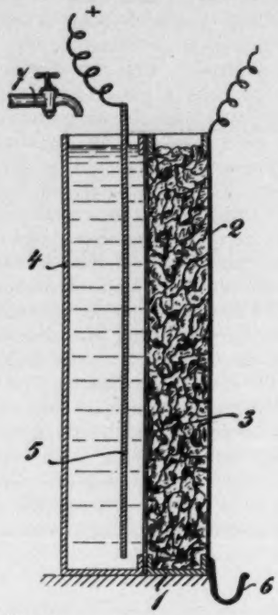
Since the days of Porret it has been well understood that a strong electric current exerts a mechanical effect upon water and solutions of non-electrolytes, transporting them from the anode to the cathode —a phenomenon known as "electro-osmose." If a porous diaphragm be interposed between the electrodes the effect is shown by the accumulation of the liquid around the negative electrode.

It is probable that this principle underlies certain well-defined but little understood manifestations of the current, some of which have been heretofore applied to commercial ends. For instance, several methods of extracting sap from wood seem to depend on this mechanical effect of the current, and the same may be said of the processes recently introduced in France by Nodon and Bretonneau for impregnating wood with various compounds for fire-proofing and other purposes. Such measure of success as has attended the electrolytic tanning methods is probably susceptible of the same explanation.

A few months ago Dr. Graf Botho Schwerin, of Munich, patented a method and apparatus for extracting moisture from comminuted materials of the most varied character—wood pulp, peat, fruits, clay sludge and beet roots—the method consisting in utilizing these materials as a diaphragm between perforated electrodes, the water being discharged through the cathode, and the device comprising a perforated cylindrical cathode, an interior concentric anode, and an intermediate helical blade to advance the material and break

up surface crusts. The latest development in this line, covered by a patent issued Nov. 26 to the same inventor, deals with the problem of the extraction of sugar from comminuted beets or cane.

These materials, as shown in the accompanying diagram, are packed between a copper wire cloth cathode, 2, and a filter-cloth diaphragm, 3, mounted on opposite sides of a box frame, 1. The anode, 5, of zinc, aluminum or other metal capable of forming insoluble salts with the acids of the crude sugar solution, is placed in water in a compartment, 4, exterior to the diaphragm, and into this compartment water is led from the tap 7 to replace that evacuated from the cathode. In operation the current performs a double function; the dissociable salts are electrolyzed, the anions uniting with the zinc or aluminum electrode and being thereby precipitated, while the alkaline bases, together with the non-electrolytes—sugars and soluble albumens—pass out with the water through the cathode to the trough, 6. Although the motorial effect of the current is certainly an expensive substitute for simple pressure as a means for forcing the solvent through the mass to be extracted, the coincident purification by electrolysis may render the method industrially practicable; data regarding the energy consumption are, however, lacking.



CELL FOR EXTRACTION OF SUGAR FROM SACCHARINE MATTER.

The Engine Builders' Association.

The third meeting of the Engine Builders' Association of the Unied States was held at Sherry's, New York City, Dec. 2, and was opened by a short address of welcome from Vice-President W. M. Taylor, of Chandler & Taylor Company, Indianapolis. At the close of Mr. Taylor's address, Professor R. C. Carpenter, of Sibley College, Cornell University, read a paper on "The Evolution of the Shaft Governor," which gave an interesting presentation of the development of the type of governor mentioned. The discussion following the reading of the paper was almost wholly on the subject of engine regulation for the parallel operation of alternating-current generators. Mr. Rites said that while satisfactory results could not be obtained with an ordinary Corliss type of governor regulating closer than about 4 per cent, the shaft type of governor made it feasible to bring the regulation within 1 per cent without incurring hunting. Mr. Samuel G. Neiler said that his experience had been that less than 4 per cent regulation was inadvisable where alternators are direct connected to engines, and pointed out that very close regulation involved a very sensitive governor, which led to excessive variations in angular velocity, and this was the chief trouble in parallel work.

The next paper read was one by Mr. H. M. Norris on "The Premium Plan of Labor Remuneration." Mr. Norris advocated the application of this plan to manufacturing enterprises. The plan consists, briefly, in paying employes the usual day wages and an additional premium for all time saved in the performance of a given operation over the time that the factory records have shown, such an operation previously required; the rate at which he proposed to compensate the workmen for saving in time was one-half of his wage rate. For example, if a workman saved two hours on a given piece of work, he was credited with two hours' time at one-half his day rate of wages. Mr. Norris cited several cases in which large reductions in the cost of given pieces of machinery had been effected by this plan. The paper was discussed at considerable length by Messrs. T. C. Wood, of the Ball & Wood Company, New York; W. M. Taylor, S. N. Bagg, of the Watertown Steam Engine Company, Watertown, N. Y.; Mr. Dick, of Dick & Church, and M. N. MacLaren, of the Ball & Wood Works, at Elizabethport, N. J.

Following the discussion, Mr. M. N. MacLaren read a paper on "Shop Administration," in which he pointed out the advantage of laying out a factory plant in such a manner that future growth would not divide the plant up into several distinct shops nor change the course followed through the shops by work in process of manufacture. This paper was discussed briefly by Messrs. Dick, Gates and Taylor.

Mr. George T. Reiss, of the Niles Took Works, Hamilton, Ohio, then read a paper on "Machine Shop Tools for Engine Builders," in which he described a number of special tools designed for the purpose of economizing both time and the labor of handling large pieces of work. The paper was illustrated by a large number of photographs and half-tone engravings. There was not a great deal of discussion of Mr. Reiss' paper, for the reason that the delegates concurred heartily in all of Mr. Reiss' recommendations. The question of using grinding machines for finishing shafts was discussed to some extent by Messrs. Reiss, Dick, Taylor and Wood, Mr. Reiss explaining that the best method of using a grinding machine is to reduce the amount of work done by it as far as possible; that is, to rough turn the shaft down to within, say, 1-64 of an inch of the finished size and then grind it true.

The closing paper of the session, entitled "From the Consulting Engineer's Standpoint," was read by Mr. Neiler. Mr. Neiler briefly defined the function of the consulting engineer in this country, and pointed out the excellent work that had been accomplished by the American Society of Mechanical Engineers and the American Institute of Electrical Engineers in perfecting standards of manufacture and standardizing methods of testing. He argued that a consulting engineer should not attempt to design apparatus, but should specify machinery that could be furnished by manufacturers without undue hardship. He also pointed out that in order to obtain the best results manufacturers should supply with their bids to consulting engineers complete data regarding their engines, so that intelligent selection can be made. He criticized the practice many manufacturers follow of doing preliminary consulting engineering work for prospective purchasers without charge. Such work, he pointed out, very rarely pays, and usually has to be done over again by the manufacturer who succeeds in landing the order in such cases where an order is actually obtained by any one. In the most of such cases, however, he said, a large amount of engineering information was given to persons who had no idea of buying the machinery concerning which they asked for the information. Mr. Neiler mentioned the offer which had been made by the authorities of the coming exposition at St. Louis to have elaborate tests made of engines exhibited there, and expressed the opinion that engine builders should take advantage of this opportunity.

In the discussion which followed, Mr. Dick said that the Chicago Exposition officials had made very specious promises as to the tests that were going to be carried on, and induced a large number of engine builders to go to great expense for exhibits, but that no tests were made of which anybody had ever heard anything.

With reference to the specifications of consulting engineers, Mr. Dick said that it seemed to him unreasonable for an engineer to require that an engine bought for operation at 100 lbs. pressure should be made able to stand 150 lbs. pressure, and Mr. Neiler explained that it is his practice not to make any such stipulation, except in cases where it is the intention to ultimately raise the pressure in order to run the engine condensing. Mr. Wood said that a feature of consulting engineers' specifications that had always seemed unfair to him was the stipulation of a bond. He thought that the manufacturer took sufficient risk in building an engine and delivering it without any bond from the purchaser as to the settlement of the account. Mr. Neiler said that he never exacted bonds of engine builders,

except where the engine was for a municipality or some State institution, in which case a bond was legally compulsory. After a unanimous and enthusiastic vote of thanks to the authors of the five papers, on motion of Mr. Gates, the session adjourned.

The Association at its second session held in New York on Tuesday, Dec. 3, confined its attention chiefly to discussing the industrial situation, especially in the engine building field, and to electing its officers for the ensuing year, etc. The following officers were elected: Mr. W. M. Taylor, of the Chandler & Taylor Company, Indianapolis, president; Mr. C. O. Gates, of the Russell Engine Company, Massillon, Ohio, vice-president; Mr. D. N. McBrier, of the Ball Engine Company, Erie, secretary, and Mr. C. S. Bonsell, of the Buckeye Engine Company, Salem, Ohio, treasurer. The two new members elected to the Council to succeed the two retiring members were Mr. Walter C. Kerr, of Westinghouse, Church, Kerr & Co., New York, and Mr. S. F. Bagg, of the Watertown Engine Company, Watertown, New York.

In the evening the annual banquet was served at Sherry's, at which some 52 gentlemen were present. Mr. Walter C. Kerr acted as toastmaster. Mr. R. H. Edmonds, of *The Manufacturers' Record,* responded to the toast, "The South." He spoke of the great possibilities of that section of the country still remaining undeveloped. Mr. Charles A. Moore responding to the toast on "Reciprocity," urged upon the gentlemen present the necessity of the maintenance of a high tariff for the protection of American manufacturers, and wandered from his subject long enough to advocate strongly an improvement in the American consular service, by sending trained men and paying them enough to enable them to command respect among their neighbors and keeping them there so long as they are competent to fill their positions creditably.

The Hon. Job Hedges responded to the toast, "Successful Builders," but skilfully evaded the subject of his toast, and impressed upon his hearers the importance of their fulfilling their duties at all times as American citizens, in a speech which was listened to with great interest by all present. The toast-master then called for a few remarks from Mr. John A. Hill, of *The American Machinist;* Mr. J. M. Wakeman, of ELECTRICAL WORLD AND ENGINEER, and Mr. Louis Cassier, of *Cassier's Magazine.* The proceedings were closed by a few carefully selected stories told by Mr. C. L. Eidlitz, president of the Electrical Contractors' Association, New York.

New Telephone Patents.

The telephone patents of the issue of Nov. 26 number four only, and two of these refer to the same device. Mr. Merritt Gally, of Brooklyn, has discovered that a Hughes microphone will produce variations of resistance even when one electrode is connected solid in the circuit and the second merely lies on it, the variation in the joint resistance of the two carbons when set in vibration having an effect similar to the variation of resistance produced by varying the pressure at a microphone contact. At least this is the explanation of the phenomenon observed by Mr. Gally, which has led him to patent a transmitter based thereon.

The primary circuit has no variable contact, but the electrode or carbon plate is connected solid in circuit with the battery and the primary winding of the induction coil. Resting on this plate is a second carbon plate, attached to the diaphragm. The movement of the diaphragm causes the latter to slide to and fro on the first carbon plate, which is stationary, and so to produce variations in the joint resistance of the two plates, resulting in induced currents in the secondary of the induction coil.

Whether a microphone built on these lines can be as efficient as a granular carbon transmitter of standard type is open to doubt, but that it is operative there can be no question. Mr. Gally, who is his own patent attorney and rather an original hand at drawing specifications, calls the first carbon electrode a "circuit-section," and the second one an "operating-conductor." Upon the diaphragm are two small supports upon which the operating conductor rests to prevent it from damping the vibrations of the diaphragm and through which the motions of the diaphragm are conveyed to the operating conductor. In his first patent Mr. Gally claims the general method of producing induced currents by means of varying the resistance in the primary circuit, according to the method described, and in his second he applies the method specifically to a telephone transmitter. Here he uses an improved "circuit-section" differing as to its conductivity in different parts of its structure. The "circuit-section" is preferably made of moulded graphite, and the "operating-conductor" may be made of any suitable material of high conductivity—graphite, carbon or the like, or preferably of platinum or brass or copper plated with platinum.

Mr. William W. Dean, of Chicago, patents and assigns to the Kellogg Switchboard & Supply Company, of Chicago, an improved granular carbon transmitter. The improvement consists in a supplemental diaphragm designed to prevent "packing" of the carbon granules. The chamber containing the carbon granules is formed by recessing the main diaphragm. The front electrode is attached to the recessed chamber and the chamber is closed by the supplemental diaphragm, which is secured by a ring and screws. The supplemental diaphragm has an opening through which passes the shank of the back electrode. This shank passes through a block and is held to the plate by a nut, the back electrode being thus clamped to and associated with the supplemental diaphragm. The rear electrode is slightly smaller than the chamber and the front electrode, allowing the granular particles to surround it as well as to lie against its face. This transmitter, which in its main idea, reminds one strongly of the Colvin transmitter of some seven or eight years ago, and in its details no less strongly of the "solid back," requires no fewer than 19 claims to set forth its various novel features.

An ingenious protector for telephone lines is patented by Mr. Charles A. Rolfe, of Chicago. A couple of "jump-out" devices, consisting of long metallic rods fitting into sockets secured in a base and held in place by the hooks and a plate against the upward pressure of springs, will break the circuit as soon as a fusible button softens under the influence of heat generated by a coil through the passage of a strong or sneak current. As soon as the button melts or softens, the hook draws away, and the tension on the springs then being released the rods are suddenly withdrawn from their sockets and the circuit is broken. This protector also carries a carbon plate lightning arrester, the plates of which are separated when the jump-out device operates.

CURRENT NEWS AND NOTES.

WIRELESS BALLOONS.—With reference to the reports referred to by us last week about Mr. Marconi's experiments with balloons in wireless telegraphy on the coast of Newfoundland, we are assured by Mr. Cuthert Hall, his representative now here, that the balloons will not, as rumored, carry passenger operators.

MANHATTAN ELEVATED.—It is stated that the new power plant of the Manhattan Elevated Company on East River and Seventy-sixth Street will be ready to deliver current to the Second Avenue line motors next week. Our issue of Jan. 5, 1901, contains an interesting illustrated article on the plant and the track.

ELECTROLYTIC ANODE.—A patent recently issued to Messrs. Hargreaves and Stubbs, of Farnworth, England, covers the latest form of compound carbon anode for use in the well-known "Hargreaves" type of exposed-cathode cell for the electrolysis of brine. As heretofore constructed these anodes have consisted of a series of more or less irregular blocks of retort carbon, bored, and fitted upon a metallic conducting rod, efficient contact being secured by casting lead in and around the joints. As now modified, the conducting rod is surrounded by a loose-fitting casing of vulcanite or other non-conducting material, pierced at intervals by metallic cross bolts upon which the carbon blocks are mounted. These bolts, while supporting the blocks which constitute the working anode, are preferably coated with insulating material in order that no portion of the current may be carried by them, this office being performed by carbon sleeves surrounding the bolts and by them pressed into close contact with the retort carbon blocks and the central conductor. The function of this somewhat fragile casing is by no means clear from the present patent specification: it is understood, however, that in practice it serves as a reservoir for mixed oil and graphite, which percolating outward through any chance fissures, closes them, or, at least, serves to prevent access of the electrolyte to the metal rod and other vulnerable parts of the electrode.

WIRELESS TELEGRAPH PLANT DEMOLISHED.—During the recent violent storm along the Atlantic coast the Marconi wireless telegraph pole plant at Southwellfleet, Mass., was destroyed by the gale.

SCHOOL FOR TELEPHONE OPERATORS.—The Central District & Printing Telegraph Company, Pittsburg, realizing the difficulty of obtaining first-class telephone operators, will establish a telephone school, where girls who aspire for a position of regular employment as telephone girls, will be taught, and when they graduate will be given permanent positions.

MAGNETIC POLE EXPEDITION.—A cable dispatch from Christiania, Norway, says: Boothia Felix has been chosen as the headquarters for Professor Amundsen's three-year magnetic pole expedition. Boothia Felix is a peninsula, and is the most northern part of the mainland of North America, having east, Boothia Gulf; north, Bellot Strait, and west, Franklin Channel. The magnetic pole is in this peninsula, the northern point of which is in about latitude 72 degs. north.

NEW YORK ELECTRICAL SOCIETY.—The society held a most successful meeting on Nov. 26, when Mr. R. T. Lozier, of the Bullock Electric Manufacturing Company, addressed a crowded audience at the College of the City of New York, on electric motors and methods of control, regulation, etc. His excellent lecture was accompanied by a large number of lantern slides, including motor equipments, circuits, curves, load diagrams, etc. Mr. Lozier was followed by Mr. Campbell Scott, of the C & C Electric Company, who gave a brief and pithy talk on their series parallel system of motor control. Mr. Gano S. Dunn, of the Crocker-Wheeler Company, also spoke. President Williams was in the chair. The evening was one of the most practical and useful that the society has had in a long time.

TELEPHONE CONNECTION WITH TRAINS.—It is announced in Chicago that the officials of the Chicago & Northwestern Railway Company are considering plans to give telephone connection between the telephone exchange and the "Overland Limited" while the train is standing in the station in that city. It is said that frequently passengers leave home for the train in a hurry and forget things they desired to carry with them. In this event they could telephone and have them brought to the train. Furthermore, business men would be able to use the telephone, either long distance or local, to transact any business which they might have neglected. It is also possible that the company may equip the train with a telephone service of its own to used in transit. By means of the device luncheons could be ordered from the dining car and communication had with the various cars composing the train without leaving the car.

ELECTRIC FURNACE.—Under date of Nov. 26 Mr. Marcus Ruthenburg, of Philadelphia, patents a simple electric furnace for agglomerating magnetite, a process somewhat fully considered in these columns last week in connection with an electric furnace operating in a magnetic field. The elements of the new furnace are a hopper, and a cylinder revolving immediately beneath its discharge orifice, both formed of cast-iron and constituting opposed terminals of an electric circuit. The charge in the hopper is evacuated by the slow rotation of the cylinder, and in passing the narrow interval between them is subjected to the full heating effect of the current, and thereby fritted into coherent masses suited for reduction by ordinary metallurgical processes. Or, it is said, the ore may be mixed with carbon and a flux and reduced to metal by a single operation. The lower end of the hopper is, of course, water-cooled, and a positive rotary movement is preferably imparted to the cylinder by means of a motor, mounted upon the hopper and actuating a worm-gear meshing with the cylinder.

PACIFIC CABLE.—In his message to Congress this week, President Roosevelt said: "I call your attention most earnestly to the crying need of a cable to Hawaii and the Philippines, to be continued from the Philippines to points in Asia. We should not defer a day longer than necessary the construction of such a cable. It is demanded not merely for commercial, but for political and military considerations. Either the Congress should immediately provide for the construction of a Government cable, or else an arrangement should be made by which like advantages to those accruing from a Government cable may be secured to the Government by contract with a private cable company." On the list of the new measures introduced in Congress are three Pacific cable bills, by Representatives Sherman, of New York; Corliss, of Michigan, and Jones, of Washington, Mr. Jones' proposing the northern route, via Puget Sound, with an appropriation of $8,000,000; Mr. Corliss' proposing a route built and maintained by the Government, and Mr. Sherman's offering the plan allowing private participation in the enterprise.

MULTI-VOLTAGE MOTOR CONTROL.—A patent granted Nov. 26 to W. S. Andrews relates to a system whereby five different voltages for motor operation may be derived from any given power circuit. Assuming a direct-current generator, on the shaft are three collector rings, which are connected to three equi-distant points of the commutator. From the brush of each ring a connection is made to one of three legs of a Y-box, or three inductive windings having a common point. The commutator brushes are connected to conductors 1 and 2 of the motor distributing circuits, and the common point of the Y-box is connected to conductor 3. Conductor 4 is connected to a balancer or double armature machine, which is in shunt with the Y-box neutral point and one of the direct-current generator brushes. Assuming that the main generator supplies 240 volts, then the difference of potential between conductors 1 and 2 will be 240 volts, and that between conductors 2 and 3 120 volts. If one winding of the balancer produces 80 volts and the other 40 volts, then the potential between conductors 3 and 4 will be 40 volts, and that between conductors 1 and 4 will be 80 volts, and between conductors 2 and 4, 160 volts.

CHRISTMAS TREE FIRES.—The executive committee of the Philadelphia Fire Underwriters' Association has felt compelled to call the attention of the public to the dangers to life and property from Christmas displays, decorations, signs, etc., in dwellings, churches, public buildings, mercantile establishments, and especially department stores. The use of Christmas greens, harvest specimens and other inflammable materials, such as scenery, cotton to represent snow, and the like (especially in connection with electric and other lighting systems), is decidedly an increase of hazard, it being impossible to make displays of that nature perfectly safe. The making of such displays would, the committee claim, under a strict interpretation of the conditions of the policy, render the contract of insurance void unless the policy is indorsed with a special permission for the increased hazard, which will generally be granted only in consideration of an additional premium commensurate with the hazard. If electricity is used in the building the permit for same in the insurance policy is subject to the following conditions, viz.: "No additions, alterations or repairs shall be made in the system of wiring, lamps or any portion of the system of wires or appliances for conducting, creating or controlling the electric current until written notice has been given to the Philadelphia Fire Underwriters' Association and an additional permit granted for such."

TESTS OF STEAM PIPE COVERINGS.—Some interesting tests have been made by Mr. George H. Barrus at the Manhattan Railway power house, New York, on condensation in bare and covered steam piping. The tests were made at two pressures—80 and 150 lbs.—and every precaution was taken to exclude extraneous factors from the results. Many of the coverings were tested day after day for a period of a month, and every one was subjected to at least three days' run of 8 to 9 hours' continuous test each day. The piping in one set of tests was 2 inches in diameter and 100 ft. long, and in other tests 10 inches in diameter and 35 ft. long. With the 2-inch piping and at 80 lbs. pressure, the condensation per hour without covering was 60.30 lbs. maximum and 55.75 lbs. minimum. Of five coverings applied, the condensation varied from 14.07 lbs. maximum and 13.46 lbs. minimum in the case of the lowest, to 15.14 lbs. and 14.60 lbs. for the highest. At 150 lbs. pressure the condensation uncovered was 72.20 lbs. and 71.75 lbs., and covered 10.93 lbs. and 10.47 lbs. for the best of four kinds of coverings, and 14.00 lbs. and 13.18 lbs. for the lowest of the tests. The 10-inch pipe was subjected only to 150 lbs. pressure, at which the condensation bare was 112 lbs. per hour maximum, and 105.9 lbs. minimum. Four kinds of coverings were tested on the large piping, from which the best results were 11.67 lbs. and 11.07 lbs., and poorest, 15.93 lbs. and 15.79 lbs.

GERMAN NERNST LAMP.—A patent issued Nov. 26 to Dr. Carl Ochs, of Berlin, and assigned to the Allgemeine Elektricitats Gesellschaft, the owners of the German Nernst lamp patents, relates to a form of this lamp which appears to be the standard of the German manufacturers. The glower is enclosed in a bulb somewhat similar in shape to that of an ordinary incandescent lamp, but with the tip end open, and having an ordinary lamp base, which screws into a socket. The glower is mounted vertically and surrounded by the spires of a heating coil. A solenoid is mounted centrally in the socket, the plunger of which cuts out the heating coil when the glower becomes incandescent. Another function of the plunger is to keep closed ventilator openings in the socket during the time the heater coil is in operation, thereby assisting the heating of the glower. The lamp socket plug is hollow, and after the ventilator openings in the socket are uncovered by the action of the plunger, the lamp is continuously ventilated.

RAILWAY MOTOR CONTROL.—The Patent Office budget of Nov. 26 adds three patents to the long list which during the past several years have been taken out on railway train motor control and assigned to the General Electric Company. The patents just issued involve so much detail that our space will permit only a summary of their objects. One of the patents is issued to Frank E. Case, and is a development of a system of motor control constituting the subject matter of a patent issued to E. W. Rice, Jr. This system relates to a train system comprising motors on the end cars, and a train control system whereby the motor equipments on the end cars may be connected either in series or multiple by means of a controller located at either end of the train, a single train conductor being employed for completing the motor circuits. In this system it is necessary that the operator may readily reverse the direction or motion of the train without leaving the car from which it is for the time being controlled. A patent by Entz is mentioned which for this purpose provided each controller with auxiliary contacts arranged to reversely connect motors on that particular car, the motors on the other car being at such times disconnected from the supply circuit. The Case patent consists in providing the train system with a separate reversing switch for each motor equipment, and a control system so arranged that both reversing switches may be actuated from the controller at either end of the train, the contacts of the controller being so arranged that either the two motor equipments on the train, or the several motors of one equipment, may be connected in series or in multiple. By this means the motors on the forward car can be operated in series or in multiple in case the other motor car is disabled or disconnected. A second of the patents was granted to A. S. Garfield and Carlos E. D'Ornellas, of Paris, France, and relates also to an improvement on the Rice system mentioned above, which does not provide means for operating the train in the reverse direction from the controller in one end of the train. One of the objects of the present invention is to provide, without any unnecessary complication, that all motors on the train may be operated in either direction from a single controller. The system is intended for operation on roads where it is not necessary that the train shall be controlled from either end, and a controller is, therefore, provided at one end of the train only. In order that the train may be operated in either direction from this single controller, separate reversing switches are provided for the motor equipments at the two ends of the train, one of which switches is to be operated directly, as by manual labor, and the other to be operated indirectely by some means which will be actuated when the directly-operated switch is moved. By the means described all of the motors of a plurality of motor equipments may be permanently connected in multiple when it is desired to cut any one motor out of circuit. The possibilities of accident in series parallel motor control system by one of the motors becoming disabled, is reduced by compelling the motorman to operate the remaining motors in multiple connection when any of the motors have been cut out of circuit. The third patent was granted to W. B. Potter and has for its object the prevention of the exchange of excessive current between motors in parallel when disconnected from the power circuit and connected for reverse rotation, but driven forward by the momentum of the vehicle on which they are installed. This is accomplished by preventing any of the motors from operating as generators under such conditions. An electromagnet is placed in the supply circuit which, when current is shut off from the motor, becomes de-energized, whereupon a mechanism connected therewith makes contacts which shunt the motor fields. On current being again supplied to the motors the electromagnet becomes energized, and the shunt connections are broken.

LETTERS TO THE EDITORS.

Signal Corps Telephone Apparatus.

To the Editors of Electrical World and Engineer:

Sirs.—Why is it that the Military Signal Corps, State and National, persist in using for field service an instrument so unsuitable as the one illustrated in No. 21, page 851, Fig. 2, of ELECTRICAL WORLD AND ENGINEER, in connection with the automobile races? A glance through any telephone manufacturer's catalogue will show a lineman's test set of some sort that would be far better for the purpose, to say nothing of the very handsome, durable and portable box telephone offered by Couch & Seeley, Lambert Schmidt, the Ericsson Telephone Company, and many others.

In 1889 I went over this matter with Lieutenant H. H. M. Borghardt, at that time in command of the Signal Corps, First Brigade, Massachusetts Volunteer Militia, our attention being riveted to the subject by the excuse of a private, who had been captured, "that he could not talk into the telephone and look around him at the same time." Recommendations were made to the military authorities of that State, but the subject was not deemed worthy of notice, no attention having ever been paid to it. Since then I have always noticed that whenever a Signal Corps was illustrated as telephoning in the field, it was invariably equipped with this style instrument, which we all know to be the worst possible shape for such service, as it cannot be conveniently carried by man, mule or horse. It takes up twice the room a telephone should in a transport wagon, and has to be hung up in some way before use, which is not always convenient or possible. These objections do not apply to the numerous test sets on the market.

In conclusion, I would say that I am not interested in pushing the product of any telephone manufacturer, but am moved by sympathy for the Signal Corps private, and by recollection of "how fearsomely they swore" when duty compelled them to "lug" or pack such an instrument as shown in above-mentioned illustration.

MOUNT SAVAGE, MD. W. M. LANNAN.

American Manufacture of Pacific Cable.

To the Editors of Electrical World and Engineer:

Sirs.—I have read with interest your editorial "Pacific Cable" in the Nov. 23 issue of your paper, and beg leave to call your attention to the fact that two of the prominent cable manufacturers of the United States have stated before Congressional committees and elsewhere, that they are willing to undertake the manufacture of the Pacific cable, by providing quickly the necessary plant and experienced employes, for the manufacture, testing and installation of such cable, if they can be reasonably protected against foreign competition, as the armor plate, tin plate, shipbuilding and iron and steel interests generally have been and are protected.

American cable manufacturers have never had any *actual* protection on deep-sea cables landing on our shores, but only a *theoretical* protection, because the jurisdiction of the United States extends only one marine league from shore, and the "theoretical" duty on such cable has been applied to but three miles of a cable thousands of miles in length, produced in foreign factories with cheap labor and cheap raw materials.

Just as soon as Congress cures the serious and apparent defect of the existing tariff laws, by an amendment imposing on foreign-made submarine cables, such a duty as shall equal the "theoretical" protection of the Dingley bill, applied to the entire length of a cable, the manufacture of deep-sea cables will become an American industry of no mean magnitude.

American manufacturers have had many years of practical and successful experience in the manufacture of underground cables, and of submarine cables of the types more common in this country, as well as in the operation of much of the machinery and processes used in making transoceanic cable, and there is no step in the process of manufacture or installation of the latter class of cable, that is not

known to certain American cable makers who have given the subject careful special study for several years past. Furthermore, the extremely careful, continuous and well understood tests, to which deep sea cables and their constituent parts are subjected at every stage of manufacture, by both the manufacturer's and the buyer's experts, will make the delivery of defective cable from Amercian factories just as impossible as though it were made in the oldest European plant.

There is no serious reason, except the one above mentioned, why American manufacturers have not long since begun, or should not now begin, the manufacture of deep-sea cable, at the point of excellence so slowly reached by foreign manufacturers, and, after a reasonable time, it may not be too much to expect that American enterprise and American genius will improve the methods of manufacture in this industry, to such an extent as to enable us to compete in the markets of the world for submarine cable orders, as we now do in steel and iron and many other products.

PITTSBURG, PA. J. W. MARSH.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Capacity of Railway Motors.—MUELLER.—The capacity of a railway motor is limited by the sparking at the commutator and by the heating of the armature and field coils. The sparking limit determines in any case the maximum current. The heating of the windings does not depend only upon the current but upon the duration of the load also. It would be very difficult to calculate exactly this dependency, taking account of all the various influences. By neglecting the heat due to hysteresis and eddy currents and the variation of the resistance with the temperature, he develops a formula which enables one to calculate for a given motor the end temperature, when the load, the duration of the load, and the temperature at the beginning, are known. This formula, of course, also enables one to determine the temperature as a function of the time. This is an exponential formula, and contains two constants which can be easily determined. Laboratory tests of a Westinghouse tramway motor gave results in good agreement with the formula. This formula may also be used to determine the cooling curve of the motor, i. e., the curve giving the temperature as a function of the time, after the operation of the motor has ceased. He shows that the cooling is very slow. The conditions of actual tramway practice are different from laboratory tests and much more complicated. The conditions may be approximately dealt with as follows: A total round trip of a car is considered and divided into the single parts in each of which the current is constant while the current may vary from part to part. He determines that current which, flowing constantly during the total time of the round trip, would cause the same end temperature of the motor as the varying load of the actual service. This current is called the "equivalent current," and may be found approximately as follows: Calculate for each part of the round trip the product of the duration and square of current, take the sum of the products for all parts of the round trip, and divide this sum by the total time of the round trip. This gives the square of the equivalent current. For good service it is necessary that this equivalent current is smaller than the current which the motor can stand for continuous lasting load without an increase of the temperature above the allowed limit. —*Elek. Zeit.*, Nov. 7.

Synchronous Converters versus Motor-Generators.—BRAUN.—A long communication referring to a recent article in which motor generators and synchronous converters had been compared and the results obtained were found to be very much in favor of the motor-generators (ELECTRICAL WORLD AND ENGINEER, Sept. 21, p. 460; see also Digest, Nov. 30). He claims that the author of that article comes to his conclusions only because he overlooks the great improvements of synchronous converters accomplished in recent years. He discusses in detail the several points of comparison and gives some data and tables. His conclusion is that in modern plants the synchronous converter is to be preferred. He describes the improvements in design, made in recent years by the Westinghouse Company. —*Elek. Zeit.*, Nov. 7.

REFERENCES.

Synchronous Converter.—BLONDEL.—The first part of his paper in full, presented to the last Internat. Electrical Congress, in which he gives a graphical theory of the regulation of synchronous converters. The paper is highly mathematical and cannot be abstracted. —*L'Eclairage Elec.*, Nov. 9.

Natural Period of Oscillation of an Alternator.—SOUBRIER.—A brief and simple proof of Boucherot's and Blondel's formula for the natural period of oscillation of a coupled alternator, running at no load.—*L'Eclairage Elec.*, Nov. 2.

Five-kw Dynamo.—A very long article, illustrated by many diagrams, in which the complete design of a 110-volt, 45-ampere direct-current dynamo is given, which can be made with the ordinary tools found in every engineering workshop.—Lond. *Elec. Eng.*, Nov. 15.

LIGHTS AND LIGHTING.

Lighting Appliances.—A long illustrated article, giving in the form of trade notes descriptions of some fittings, appliances and novelties, for the current lighting season. Among them are Siemens' solid system of main laying; the Traveller light fitting; Union arc lamps, electrical illuminators; America electrical novelties; the Jandus arc lamp; the Edison incandescent lamp of the British Thomson-Houston Company; steel conduits pendant fittings; a new electric gas lighter; the Turret multiple distributor; gas-tight fuse box; heating and lighting appliances of the Gen. Elec. Co.; vulcanized rubber cables and wires; several fittings; heating and cooking appliances; the Stewart "Continental" enclosed arc lamp, etc.—Lond. *Elec. Rev.*, Nov. 8.

REFERENCE.

Photographs of the Arc.—SCOTT.—An illustrated article on photographs of the electric arc.—*Sc. Amer.*, Oct. 19.

POWER.

British Electric Plant and Dust Destructor.—An article on the opening of the Hackney electric plant. The present capacity of the generating plant is 3000 horse-power. The system is a low-pressure, direct-current, three-wire supply, with 240 volts at the consumers' terminals. For power purposes the pressure will be 480 volts. The dust destructor will not be in working order until early spring. Then there will be sufficient steam raised by the destructor to run cheaply one of the small sets (300 kilowatts) so that coal fuel will be used chiefly. The refuse destructor consists of 12 furnace cells, capable of burning 160 tons of refuse in 24 hours. Arrangements have been made for the automatic handling of the refuse, so far as this is possible, from the moment it is tipped at the works to the time when it emerges from the furnaces in the form of clinker.—Lond. *Elec. Rev.*, Nov. 8.

REFERENCES.

Californian Transmission.—HEITMANN and CURRIE.—An illustrated description of the generators and transformers for the Bay Counties Power Company in California.—*Eng. News*, Nov. 21.

Gas Engines.—BURSTALL.—A long illustrated report with many tables, presented to the Brit. Inst. Mech. Eng., on gas engine research.—Lond. *Enging.*, Oct. 25, Nov. 1, 8.

TRACTION.

Italian Electric Railway.—REYVAL.—A very long and well illustrated article on the development of electric traction in Italy. On the Lecco-Chiavennu line three-phase motor cars will be used, the Milan-Gallarate Railroad will be operated by 650-volt direct-current. Storage battery cars are used by both railroads on such branch lines on which the traffic is not extended enough to justify a permanent installation. A very detailed description is given of the Milan-Gal-

larate Railroad, which, with three extensions, has a total length of 78 miles. Water power is used for the generation of 13,000-volt, three-phase currents, which are distributed to sub-stations and converted there to 650-volt, direct-current, at which pressure the current is supplied to the motor cars by means of the third rail. The description of this line is profusely illustrated.—*L'Eclairage Elec.*, Nov. 2.

REFERENCES.

Emergency Brake for Electric Cars.—A powerful brake instantaneously applied to the wheels simply causes them to skid. An emergency brake must act on the track itself, and be entirely independent of the brake on the wheels. Such a brake designed by Hewitt and Rhodes is described and illustrated. The brake acts directly on the rails and is worked by means of air pressure, procured from a compressor driven by one of the axles of the car.—Lond. *Elec. Rev.*, Nov. 15.

Dynamometric Brakes.—Guillaume.—An illustrated article on magnetic and electromagnetic brakes. The Siemens & Halske, and the Pasqualini brakes are described.—*L'Eclairage Elec.*, Nov. 9.

Rail Chair.—Koetensky.—A report on the use of the Scheinig & Hofmann rail chair on the electric railway between Linz and Urfahr, Austria. The rails are wedged together by means of a "rail shoe" without spikes. The installation has proved very satisfactory.—*Zeit. f. Elek.*, Nov. 10.

Electrolysis by Return Currents.—Wheeler.—A communication on cases of the destruction of gas pipes by electrolysis, due to careless soldering of the rail bonds of the tramways.—*Eng. News*, Nov. 21.

Installations. Systems and Appliances.

British Station.—A description of the electric plant of the Hackney Borough Council, which is not yet completed, although the supply for public and private lighting has been started. There will be a refuse destructor in combination with the plant. The generating plant consists of two 1000-hp engines and two 500-hp engines, each driving two direct-current dynamos. The three-wire system is used with 240 volts between the outers, and one dynamo is connected to each side of the system. The batteries are connected across the outers with the regulating cells in the middle. The battery is a very large one, there being 304 cells with a capacity of 2800 ampere-hours on a four-hour discharge and capable of giving 1500 amperes for one hour.—Lond. *Elec.*, Nov. 1. (See item, page 947.)

REFERENCES.

General Electric Company's Constant-Current Transformer for Alternating Series Arc Lighting.—The full illustrated report of a Franklin Inst. committee, which recommends the award of a prize to Elihu Thomson for this invention.—*Jour. Frank. Inst.*, Nov.

British Lighting Station.—An illustrated description of the Heywood electric plant. The direct-current system is used. The station contains two 60-kw sets and a battery of 230 cells with 350 ampere-hour capacity.—Lond. *Elec. Rev.*, Nov. 8.

Wires, Wiring and Conduits.

Insulation and Insulating Material.—Kessler.—An article, illustrated by various diagrams. He first deals with turn and layer insulation. Two pieces of double cotton covered wire lying side by side, with only the thickness of the cotton between them, which will be about .009 inch in the case of a No. 18 wire, will stand approximately 1000 volts. This insulation is that of air, the cotton serving simply to space the wires. He then discusses the insulation to be used between flat surfaces which are of considerable potential differences. Cellulose materials, such as paper, fibres, fullerboards, pressboards, etc., are all quite hygroscopic. They are to be dried out and covered with a layer of insulating varnish, which is moisture proof. The drying out must, however, be somewhat limited to prevent too great a loss of flexibility, resistance to tearing forces, etc. As insulating oils, the animal and vegetable oils are not practical, as they easily saponify and form fatty acid salts with the metals. The influence which small amounts of water exert with respect to the insulation of oil, is very great. Mineral oils are undoubtedly hygroscopic. There is probably little difference in the insulation of perfectly dry mineral oils ranging from benzine to cylinder oil stock, or from the very light to the very heavy oils. Both of these advantages are questions of viscosity, as the lighter oil circulates much more rapidly, exposes fresh portions continually to the dielectric stress and carries off the heat. Light oils cannot be used, however, on account of increased fire risk, and a mineral oil must be chosen which will be neither too viscous nor too light.—*Rose Tech.*, Nov.

REFERENCE.

Voltage Drop in a Three-Phase System.—Stock.—An article illustrated by diagrams, in which he describes how to calculate the voltage drop in a three-phase system, taking into account induction and phase difference.—*Elek. Anz.*, Oct. 31.

Electro-Physics and Magnetism.

Optical Electric Phenomenon.—A note on an observation made by Bose. When an electric current is passed through a slightly acid solution for a long time with gold electrodes, the anode alters considerably in appearance, becoming coated with a covering of gold hydroxide. If now the charging current be stopped and the electrodes connected to a high resistance galvanometer, it is found that the e. m. f. of the combination depends on the illumination of the oxidized gold electrode. The differences in e. m. f. obtained amounted in some cases to as much as 0.1 volt, very strong lights such as the arc, magnesium light, Welsbach light, etc., causing the potential of the electrode to drop. The different actions of the various parts of the spectrum are interesting. Pure violet light has the same effect as white light, i. e., lowers the potential. Sodium light, and the yellow and green parts of the spectrum have hardly any effect. Red light raises the potential even to an amount greater than the high value reached in the dark. Röntgen rays have a very strong action similar to white light. "It is possible that practical good may result from these observations. If the effect is proportional to the cause, i. e., to the illumination, which seems probable, the phenomenon may form the basis for the construction of a direct reading photometer, that apparatus so earnestly desired by all who have to do with photometric measurements."—Lond. *Elec. Rev.*, Nov. 8.

Chemical Action or Radium Rays.—Berthelot.—He has discovered some interesting chemical changes produced by radium rays. The first reaction described is the decomposition of powdered iodic acid into oxygen and iodine after being placed next to the radium tube in the dark for nine days. In this reaction the rays not only determine the action, but furnish the necessary energy. Another endothermic reaction, which is common to sunlight and to radium rays, is the decomposition of nitric acid. The rays, on the other hand, are not capable of precipitating sulphur from its solution in carbon bisulphide, as is done by sunlight.—*Comptes Rendus*, Oct. 28; abstracted in Lond. *Elec.*, Nov. 15.

Law of Magnetic Induction.—Muellendorf.—An article in which he develops formulas for the relation between the magnetic induction B and the field intensity H. From theoretical reasoning he develops two different sets of formulas which are equally probable; but only the one set is in accordance with the facts. He shows that the experimental results for three different kinds of iron and for hard steel may well be represented by the formula

$$B = a\left\{1 - \frac{1}{\left(1 + \frac{k^m}{m\,n}\,H^m\right)^n}\right\} + H$$

in which a is the maximum limit of the difference between B and H, and k, m, n are constants. For wrought iron and cast iron is $m = 2$ and $n = 0.5$. If instead of the field intensity H, the magnetizing force M is given as ampere windings per centimeter, H in the above formula is to be replaced by $c\,M$, when c generally depends upon the form of the coil and is a numerical coefficient to be determined empirically.—*Elek. Zeit.*, Nov. 7.

REFERENCES.

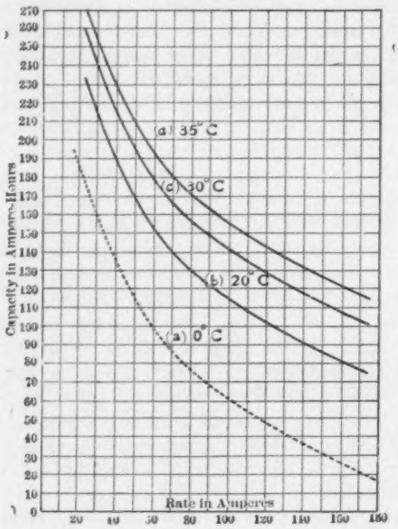
Vector Analysis.—Punga.—The conclusion of his illustrated article, the first part of which was noticed in the Digest, Nov. 16. He explains the topographical method of treating alternating-current phenomena by means of Grassmann's "Ausdehnungslehre."—*Zeit. f. Elek.*, Oct. 27.

Resonance.—Turpain.—A French Ass'n Adv. Sc. paper on the phenomena of electric resonance in rarefied air.—*L'Eclairage Elec.*, Nov. 2.

ELECTRO-CHEMISTRY AND BATTERIES.

Electro-Chemistry.—NERNST.—Abstracts of a lecture, held before the German Association of Natural Philosophers and Physicians on "The importance of electrical methods and theories in chemistry." The following hypothesis, brought forward by him, seems remarkable. Since the time of Faraday, we know that equivalent quantities of all elements are always combined with the same quantity of electricity. For the description of this fact we may use the following scheme: Electricity may be regarded as a matter having atomic structure, and consisting of positive and negative electrons; the ions may be regarded as the chemical combinations of the elements with such electrons. An ion is then a saturated chemical combination of an atom and an electron. A sodium ion, for instance, is, therefore, entirely different from a sodium atom, as it is a combination of a sodium atom with a positive electron. All elements or radicles have affinity to positive as well as negative electrons, with which they form ions; they have besides a non-polar attraction to each other, which, for instance, causes the combination of two hydrogen atoms to a hydrogen molecule. When positive and negative elements combine there is, besides the combination of the two atoms, also a combination of a negative and a positive electron; and in the case of electrolytic dissociation, there is not a pure chemical dissociation, but an electric molecule is also split up. This hypothesis is not at all complete, but it is thought to be justified because it stirs up future scientific work.—*Zeit. f. Elektrochemie,* Nov. 14; *Phys. Zeit.,* Nov. 15.

Influence of the Temperature Upon the Capacity of Lead Storage Batteries.—LIAGRE.—An article referring to the great increase of capacity with the temperature, about 3 per cent per degree Celsius (see Digest, Nov. 16, article of Heim). Manufacturers and engineers, when giving the capacity of a battery should always state the exact temperature at which the test was made. He made experiments with a battery, both plates of which were of the Plante type, the active surface being 348 square decimeters for each electrode. Tests were made for temperatures betwen 16 dgs. and 70 dgs., and for various rates. The capacity for a given rate can be fairly represented as a linear function of the temperature; the capacity of his cell, within the limits of his measurements, is given by the sum of the extrapolated capacity at 0 deg. C. plus the product of the temperature in Celsius, and a constant, which varied between 2.55 and 2.80 for different discharge rates. For a cell with 1 square meter of active surface of each electrode, the temperature coefficient of the capacity per deg. C. is, therefore, $2.70 \div 3.48 = 0.77$. The increase of the capacity with the temperature is much greater for rapid discharge than for slow discharges. The adjoining diagram shows in the three curves (b) (c) (d) the capacity in ampere-hours at 20 degs., 30 degs., 35 degs. C. as a function of the rate in amperes. The curve (a) is found by extrapolation for 0 deg. C.—*L'Eclairage Elec.,* Nov. 2.



INFLUENCE OF TEMPERATURE ON STORAGE BATTERIES.

Electro-Chemistry in France.—J. B. C. KERSHAW.—The third part of his serial in electro-chemical and electro-metallurgical industry, dealing with the progress made in France, where there is plenty of water power available. Eleven electro-chemical and electro-metallurgical works have 54,000 hp derived from waterfalls. The number of electrolytic copper refineries is eight, and it seems improbable that this industry can develop in France, on account of the scarcity of raw copper suitable for refining. There are two plants for the production of aluminum, one with 5000 horse-power at Le Praz, using the Heroult process, the other with 4000 horse-power at St. Michel, using the Hall process, but not all of the 4000 horse-power are used for the production of aluminum. Chlorate is made at St. Michel, under the patents of Gall and Mortlaur, cells without diaphragm being used with platinum electrodes. Chlorate is also made by a similar process at Chedde, where 12,000 tons are available. The calcium carbide industry has developed to a greater extent in France than in any other European country. A moderate estimate of the power available in the 26 carbide factories places it at 50,000 horsepower. The growth of the alkali and chlorine industry has been slow. It is possible that early in 1902 there will be four electrolytic alkali works. Ferro-chrome, ferro-silicon and other similar alloys are produced in electric furnaces at several places. The production of ozone by the silent electric discharge through air, and the use of this ozonized air for sterilizing water, for oxidation purposes in the manufacture of perfumes, and for ageing wines and spirits, have received much attention in France. In only one case has a practical success been achieved, namely in connection with the manufacture of heliotropine and vanilia. The Verley ozonizer is used in this plant, near Paris, and 10,000 kegs of the two products named are produced per year. The experiments, made with the Hermite sewage disinfecting process at Havre and Marseilles, about 1890, have not led to any practical success. This process, in which electrolyzed seawater was used, resembled the Wolff process tried at Havana in 1899, and failure in each case was due to excessive cost.—*Elec. Rev.,* Nov. 23.

Straying of the Lines of Current in Electrolytes.—PFAUHAUSSER.—In elctro-plating one wants to obtain a uniform deposit on the surface to the plate. This is often not the case when this surface has a very irregular form with elevations and deepenings. It is especially difficult to get a good uniform deposit of an alloy, for instance, of copper and zinc in the form of brass. To accomplish this, one has to use electrolytic baths which stray the lines of current well. He compares the straying of the lines of current in electrolytes with the magnetic stray fields in dynamos. The electrodes correspond to the magnet pole and armature, the electrolyte corresponds to the air-gap. To get uniform electrolytic deposits on special surfaces, mechanical means are sometimes used to advantage. Non-conducting diaphragms are placed between anode and cathode, to deviate the lines of current in the way desired, or for covering a plane surface with a uniform coating, and to prevent the coating from being thicker at the rims than at the central part, a non-conducting frame is placed before the cathode, the open part in the middle of the frame being smaller than the cathode. He discusses the influence of the composition of the electrolytic bath upon the phenomenon of the straying of lines of current. He calls attention to the fact that acid solutions stray less than neutral or alkaline solutions. He gives an explanation which is highly theoretical and cannot well be briefly abstracted. He mentions that practical experiments have shown that the addition of Na H SO_3 to the electrolytic bath is a means for obtaining good uniform deposits of copper and zinc together as brass. —*Zeit. f. Elektrochemie,* Sept. 26.

Diaphragm Cells for the Production of Alkalies and Chlorine.—J. B. C. KERSHAW.—After a brief notice of the four types of diaphragm cells, now in actual use, namely, the Electron, the Le Suever, the Hargreaves-Bird and the Outchenin-Chalandre cells, he gives a detailed illustrated description of a new cell of American origin. It is patented by Moore, Allen, Ridlon and Quincy, and in many respects resembles the Harbreaves-Bird cell. The advantage claimed for the new cell over the Hargreaves-Bird cell is that no steam is required, and that the design and structure of the cells are simpler. The author considers the cell to be defective in one very essential point, namely, that there are no means provided for quickly removing the sodium hydrate which is formed; if it is not quickly removed, it is decomposed by the current in preference to the sodium chloride.—Lond. *Elec.,* Nov. 15.

Carbon Anodes for Electrolysis of Chlorides of Alkalies.—SPROESSER.—The first part of an account of experiments in which he tested different commercial kinds of carbon for use as anodes in the electrolysis of chloride of alkalies. He tested three kinds of retort car-

bon, seven kinds of artificial carbons, and one kind of graphite. He gives some data as to the chemical composition, the heat of combustion and the porosity. The porosity is given in percentages and defined as 100 times the difference of true specific gravity and apparent specific gravity, divided by the true specific gravity. The porosity varies between 12.6 and 18.3 per cent for the retort carbons, between 18.4 and 27.8 per cent for the artificial carbons, and is 23.2 per cent for graphite. He describes the arrangements of his experiments without a diaphragm. The article is to be continued.—*Zeit. f. Elektrochemie,* Nov. 7.

REFERENCE.

Peigne Storage Cell.—An illustrated description of this lead storage battery, made by a French company. The watt-hour capacity per kilogram of plate is 6.6, 8.6 and 10.1 for discharges in 3, 5, 10 hours, respectively. The capacity per kilogram of total cell is not given.—*L'Eclairage Elec.,* Nov. 9.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Localizing Faults and Testing the Insulation of Electric Networks.—CHARPENTIER.—A very long article, illustrated by diagrams. He first gives the principle of the method which is shown in Fig. 1 (and which is not new). An earth-fault has developed somewhere on the circuit *A B C D*, or on the branch circuit *F G E H*. To localize the fault, *G* and *H* are disconnected from each other, and *B* and *D*

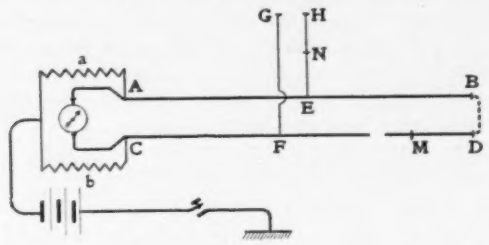


FIG. 1.—TESTING FOR FAULTS AND INSULATION.

are connected together; a galvanometer is inserted between *A* and *C*. At *A* and *C* the two resistances *a* and *b* are connected, as shown in the figure, and the point where these two resistances join is connected through a battery to earth; *a* and *b* are known variable resistances. They are varied until the galvanometer shows no deflection. If *R* is the total resistance of the loop *A B C D*, two resistances *x* and *y* may be easily found, the sum of which is *R*, and the ratio equal to that of *a* to *b*; *x* and *y* represent then the point on the line where the ground exists. This follows from the principle of Wheatstone's bridge. If the point found is at *E* or *F*, the ground is on the branch circuit *E H F G*, and to determine it exactly it is necessary to break the connection *B D*, connect *G* and *H*, and repeat the same test (but this is correct only when the resistance per foot is the same on the branch wire as on the mains). He claims that the method is not very exact, as there are errors due to the resistances of the joints of the line. To overcome these errors he has devised the following scheme: He does not test the network itself, but another network, formed of pilot wires, which is parallel to the real network throughout its length, and which has the property that when a fault develops in the real network it also develops

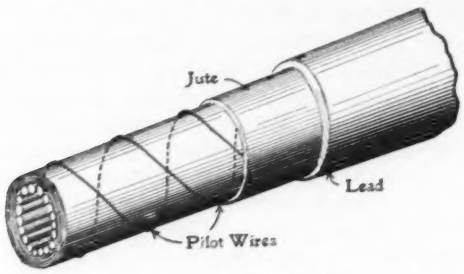


FIG. 2.—ARRANGEMENT OF PILOT WIRES.

probably but not necessarily at the same time and at the same place in the pilot wires. The pilot wires can always be easily tested, so that there is a possibility of continually testing the insulation of the network and immediately ascertaining a developing fault. To accomplish this, the pilot wires are arranged, as shown in the second figure, which shows a cable of the network. Between the last and the preceding layers of jute the two pilot wires are wound in spirals; they are bare copper or brass wires of some tenth's millimeter diameter. (To avoid complicated calculation, however, the pitch of the spiral must be a function of the diameter of the cable, as the resistance per foot of cable should be the same for all cables. He says this arrangement could easily be made in the construction of the cable and would be inexpensive.—(If in the first method—Fig. 1—the battery is placed where the galvanometer is, and vice versa, better results will be obtained for faults with an appreciable resistance or counter e. m. f. due to electrolysis, as there is then no current passing through the fault, it being a mere contact point for the galvanometer circuit.—Comp.)—*L'Eclairage Elec.,* Nov. 9.

Voltameter for Small Currents.—LEHFELDT.—An abstract of a Brit. Phys. Soc. paper on a voltameter for small currents. The instrument consists of a capillary tube about 25 cm. long, completely filled with mercury, with the exception of a bubble of mercurous nitrate solution about 1 cm. long, placed near the middle of the tube. Connection with the two mercury columns is made by means of platinum wires passing through the side of the tube. To use the instrument it is placed in a vertical position, the anode being at the top, and the quantity of electricity which passes through is measured by the change in volume of either electrode. In a test experiment the change in volume was measured by means of a micrometer, and agreed within 0.6 per cent with the amount deduced from the known value of the current. It is necessary that the currents should be small, so as to avoid complications due to polarization.—Lond. *Elec.,* Nov. 15.

Electromagnetic Units and Unit of Time.—REY-PEILHADE.—A French Ass'n Adv. Sc. paper on a reform of the electromagnetic units by means of the adoption of a new unit of time, the "millice" which is the 100,000th part of the average day (about 0.864 second). His system is called millice-centimeter-gram system. The units have names with the prefix "no"; for instance, nowatt is the unit of power in his new system. A comparative table of the units in the centimeter-gram second system and in his new system, is given.—*L'Eclairage Elec.,* Nov. 2.

MISCELLANEOUS.

Aluminothermic Process of Soldering.—GOLDSCHMIDT.—A long illustrated description of a modification of his well-known process. The total quantity of thermit required is put into a crucible in the form of a funnel, the opening at the lower end being closed by a thin plate of iron. When the thermit is lighted at the surface by means of match or hot iron, the total quantity of thermit in the funnel burns in a few seconds, the molten metal is at the bottom and melts the thin iron plate and flows out, so that the metal flows out first and afterwards the lighted corundum. This is the reverse of the usual method, in which when the contents of the crucible are poured out, the lighter corundum first flows off and then the metal. The new method cannot be used for all the cases to which the old method is adapted, but is especially useful in certain cases, like soldering rails. The new method and several of its applications are described in detail and illustrated.—*Zeit. f. Elektrochemie,* Oct. 17.

Locating Metals by Electricity.—An illustrated description of a new method for locating metals in the earth. The principle upon which the method rests is that a metallic streak in the earth is a better conductor than the earth on either side of it. Movable electrodes are used which are connected with a Wheatstone bridge and other apparatus for measuring resistances. These electrodes are moved about a regular system over a given area in such a way as to obtain the measurement of a large number of resistances in various directions, and by a comparison of the various measurements one can ascertain where the current is taking a metallic streak or deposit as a conductor.—*West. Elec.,* Nov. 16.

REFERENCES.

Electric Furnace for Laboratory Use.—HOWE.—An illustrated paper read before the A. I. Min. Eng., in which he describes an electric resistance furnace for laboratory use. The heating wire is of platinum. The furnace walls and the crucible are of magnesia.—*Eng. and Min. Jour.,* Nov. 16.

National Electrical Contractor.—The first number of a new monthly journal which is the official organ of the National Electrical Contractors' Association. Besides the news of this association, it contains a few brief notes on 200-volt incandescent lamps, the Nernst lamp, etc.—*Nat. Elec. Contr.,* Nov.

New Books.

TRANSACTIONS OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEER. Vol. XVII. New York: American Institute of Electrical Engineers. 822 pages, illustrated.

The 1900 volume of the *Transactions* of the American Institute of Electrical Engineers is in several respects one of the strongest in the entire series of Institute *Transactions*, and contains perhaps the most notable paper lately read before the Institute, that in which Dr. Pupin first announced his system of compensating long-distance telephonic air lines and submarine cables for the deleterious effects of capacity. Another notable paper in this volume is that of Messrs. Crehore and Squire on a new system of cable telegraphy. Still other papers that form contributions of permanent value to the literature of electrical engineering are those of E. A. Behrend on the magnetic pull on decentralized armatures; hysteresis in sheet iron and steel, by A. H. Ford; eddy-current losses in transformers, by Fitzhugh Townsend; use of aluminum line wire and some constants for transmission lines, by Messrs. Perrine and Baum, and Mr. Steinmetz's paper on single-phase motors.

Of the several discussions there should be mentioned those on electric traction under steam railway conditions and on electrolytic corrosion from railway currents, and the Paris discussion on the relative advantages of alternating and direct current for the general supply of electricity. This latter topic, which was discussed at Paris, was selected by our English brethren, and it will be long before American engineers will have recovered from their surprise at the serious manner in which the foreign participants in the discussion considered a question, almost all interest in which had ceased in this country at least ten years ago, for the very good reason that American development had so long ago as then shown the absurdity of considering these two branches of the electrical art as antagonistic.

Mention should not be omitted of the excellent paper by Professor Carhart on the Reichanstaldt at Berlin, the reading of which before the Institute was particularly opportune in that the paper undoubtedly had a considerable influence in securing the passage by Congress of the bill establishing the National Standardization Bureau.

The present volume has been considerably improved with respect to the opening pages and the indexes. The title page no longer bears extraneous matter, and the list of officers and members of the Council has been transferred from the copyright to the following page, ordinary book style thus being followed. The index is in three sections under the heads of "Business of the Institute," "Subjects Discussed Before the Institute," and "Authors of Papers and Participants in Discussions."

COURS D'ELECTRICITE. By H. Pellat. Tome I. Paris: Gauthier-Villars. 329 pages, 145 illusttrations. Price, 10 francs.

This book is the first of three volumes giving the course of electricity as taught at the Sorbonne by Professor Pellat. The work is divided into three parts, the present volume taking up electrostatics. Ohm's law and thermo-electricity, and the following volumes will comprise the subjects of electro-dynamics, magnetism, induction, electrolytics, electro-capilarity, etc. The development follows the usual academic method, general descriptions of phenomena being accompanied by their mathematical expression, with some references to their practical role. The author has confined the mathematics as far as possible to a kind that will be easily within the reach of the average student, and to this end only the simpler calculus is employed. The author departs from the usual treatment of electrostatics founded on the laws of Coulomb, the experimental base of which he considers inexact, owing to their not taking into consideration the medium between the acting bodies, since the specific inductive capacity and, therefore, the force acting depends upon the several dielectrics that may intervene.

ETUDE SUR LES PARATONNERRES. Par A. Della Riccia. Liege: Leon de Thier. 81 pages, 41 illustrations.

This is an extract from a *Bulletin* of the Alumni Association of the Institut Electrotechnique Montefiore. While no attempt has been made by the writer of this monograph to advance any new theories, he has nevertheless succeeded in condensing within a very small compass the fundamental principles underlying the modern applications of the lightning rod. To this he has added a number of useful practical examples, and as a handy compendium, therefore, the little pamphlet has a distinct value. Those, of course, who desire to go more deeply into the subject will find fuller elaboration in Dr. Lodge's classical work on the subject. Even should they do so, the present work will be of value from its practical nature and as giving the latest thought on the subject. The pamphlet before us does credit both to the author and to the excellent Institute from which he graduated.

PRACTICAL X-RAY WORK. By Frank T. Addyman, B. Sc. (Lond.). New York: D. Van Nostrand Company. 207 pages, 52 illustrations, 11 plates. Price, $4.

This is perhaps the first working handbook on Röntgen rays from the standpoint of their medical applications, that has yet been published. The author appears to be well qualified for the work, since he occupies the position of radiographer to St. George's Hospital, London, and is a teacher of radiography in a medical school.

The book is divided into three parts, of which the first is historical, the second describes apparatus most generally used, giving special attention to induction coils and focus tubes, and the third part deals with the general practical conditions under which Röntgen rays are used in medical work. The author in his preface refers to the natural difficulty with which he met in preparing the book, owing to the fact that being intended for medical men, many prospective readers will not have a proficient knowledge of electrical science. As a way out of the difficulty the author has taken as a starting point as to electrical knowledge the requirements of the examination for qualification to the Royal Colleges of Physicians and Surgeons.

About half of the book is devoted to apparatus and its manipulation. An excellent chapter in this section is on tubes, in which the author gives much practical information on this part of the apparatus, which in the hands of a beginner is subject to such apparently unaccountable vagaries. The second part of the book treats entirely of practical Röntgen ray work, and will be found of the utmost value to the medical man, since the information contained is presented in practical form for their specific needs. Even from the standpoint of a general descriptive treatise the book is much above the plane of the usual compilations treating of Röntgen rays.

POCKET BOOK OF ELECTRICAL ENGINEERING FORMULÆ. By W. Geipel and M. Hamilton Kilgour. New and enlarged edition. New York: D. Van Nostrand Company. 829 pages, illustrated. Price, $3.

This is a revised edition of the Electrical Engineering pocket book that the authors first issued in 1894, and which has ever since held a foremost place among the reference volumes of its class printed in the English language. Thinner paper has enabled a reduction in bulk in spite of the addtion of about 50 pages of fresh matter, and brings it down to a point where it can be conveniently carried in the pocket.

In contradistinction to a usual practice with pocket books, the revision has not been effected by merely adding an appendix or inserting a few extra paragraphs at the end of each chapter, but bears evidence of having been carefully considered and carried on with less reverence for the retention intact of the original electrotyped page plates than is ordinarily the case.

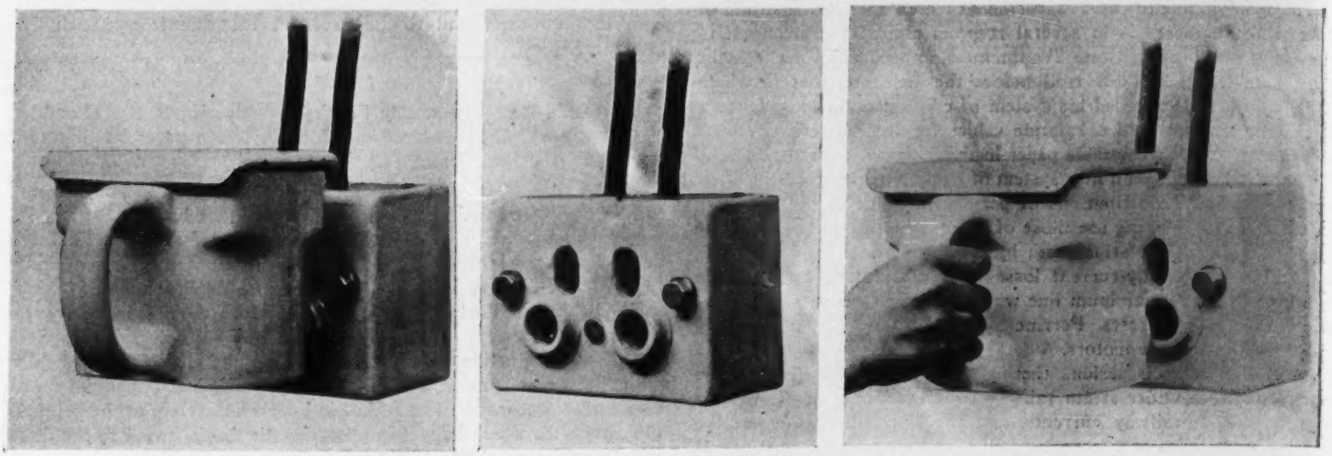
As is to be expected, the first parts of the book containing tables, mathematical formulæ and general miscellaneous engineering data have not required extensive correction, a few tables that should be found convenient having been inserted together with comments on modern practice in the way of steam engineering, condensers, etc.

In the purely electrical section occupying the last 300 pages the progress of the art has necessitated greater revision. The entire chapter on "electric traction" that took up but 19 pages in the first edition has been rewritten and brought up to 56 pages in the present issue, this having been done with the collaboration of Mr. Justus Eck. Of course, even now it is by no means suitable for a text book on the subject, but for the class of information usually sought for in engineering pocket books it would seem to answer well.

Other sections that have been revised are those treating of enclosed arc lamps, storage batteries, high-voltage incandescent lamps and electric welding. Strange to say, the chapter on electro-chemistry in which branch the most notable advances have been made remains absolutely untouched, three brief pages still comprising the only contribution to this most important subject.

New Form of Oil-Break Fuse.

The need of a really satisfactory fuse and the difficulty in obtaining it has, in many instances, necessitated working without them in places where they would otherwise have been used to advantage. Messrs. S. Z. de Ferranti, Limited, of London, have furnished a remedy for this by manufacturing an oil break plug fuse which, combined with a special type of contact block, can be added to any circuit, fixed on to any type of switchboard, or even on to a wall in a central or sub-station.



FIGS. 1, 2 AND 3.—OIL-BREAK FUSE.

The illustrations represent this useful device, Fig. 1 showing the plug fuse in position. The cable will be seen entering from the top, although the block can be easily mounted in the reverse direction for the cables to enter from below. Fig. 3 represents the withdrawal of a fuse from its contact, no special tool or, in fact, any apparatus being required for this operation. Fig. 3 shows the block attached to the wall or switchboard after the removal of the fuse. It will be seen from this illustration how securely the metal sockets are shielded by the surrounding porcelain. It is quite impossible to make accidental contact with either the metal terminals or the plug sockets, both these fittings being out of sight under the surface of the porcelain. The metal fittings are held into the porcelain block by sulphur compound, and this compound is recessed where the cables enter so that the rubber paper covering can pass the socket so formed. By these precautions a method for sealing the end of the compound or cable is obtained, at the same time preventing the exposure of the live cable end.

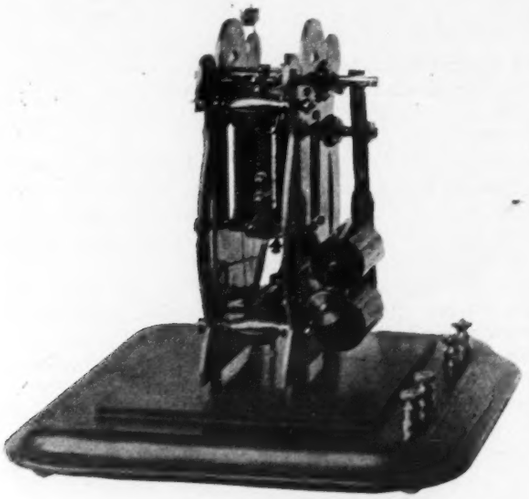


FIG. 1.—AUTOMATIC DEVICE.

This useful combination is produced in several sizes for capacities varying between 30 and 350 kilowatts. They are equally applicable for 500 volts, direct current, or 2000 to 5000 alternating current circuits. Even on 250-volt circuits, it is found that the oil break fuse is advantageous where an inductive circuit is likely to be broken. Experiments have shown that the usual strip type of fuse, in blowing, causes considerable damage to the fuse contacts and to the surrounding parts of the switchboard, whereas an oil break fuse will act on the same circuit without a disturbance.

It is unnecessary to describe the details of the actual fuse, which is of the well-known Ferranti type, in which the arc produced on the break of a circuit is drawn into a bath of oil and so immediately damped. It is interesting to note the care which has been taken in producing a safe apparatus. This feature is one of the characteristics of the manufacturers, and needless to say it is an essential one, especially when dealing with high-tension systems.

Selective Lockout Party-Line System.

The accompanying illustrations refer to a selective lockout party line system known as the "Ideal," and manufactured by the United States Electric Manufacturing Company, of Butler, Pa. This system is capable of application to existing exchange boards, and is especially adapted to farmers' lines. Any number of telephones up to

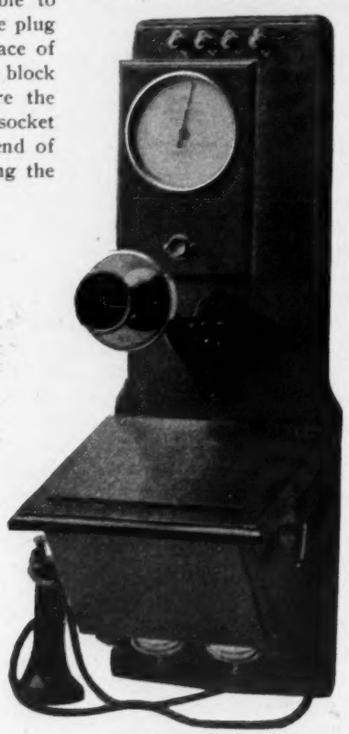


FIG. 2.—TELEPHONE SET.

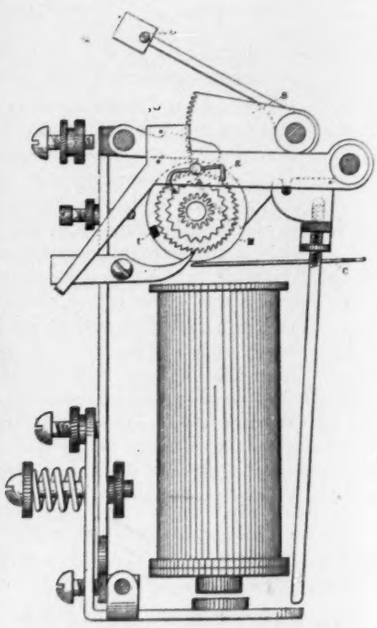
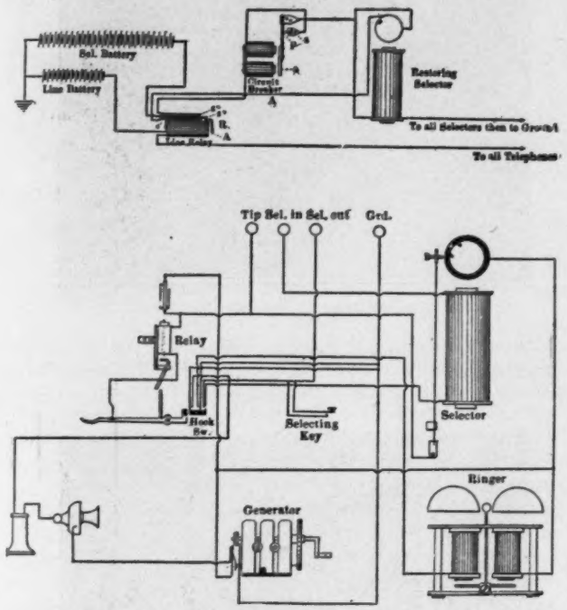


FIG. 3.—AUTOMATIC BATTERY CIRCUIT.

35 can be operated on a single line. This system involves the lock-out principle, thus ensuring secrecy. Through the selective feature only the subscriber called is rung up, and the exchange system is entirely automatic, each subscriber connecting himself with any other subscriber.

Fig. 2 shows a telephone set installed, and Fig. 1 illustrates the automatic device, which is also shown in section in Fig. 3. Fig. 4 is a diagram of the line circuit, and Fig. 5 that of the telephone circuit. The line circuit includes the line battery, selector battery, line relay, circuit breaker and the restorer selector or battery cutout. All of the batteries work on open circuit. When the receiver is taken off its hook a contact is made grounding the tip of the line, which pulls up the line relay (Fig. 4), which in turn closes the selector battery through the circuit-breaker, and also closes the telephone circuit at the relay (Fig. 5), this in turn holding the line relay after the contact is broken. The selector battery is now open at the selecting key (Fig. 5) which, when it closes, immediately operates the circuit-breaker, which stops all the selectors on the line when the desired station is reached, as indicated by the dial and indicator (Fig. 1). When the selective key is released the party line is called by the usual method. Upon hanging up the receivers the line battery is opened (Fig. 4), and the line relay drops back, thus throwing the selector



FIGS. 4 AND 5.—LINE AND TELEPHONE CIRCUITS.

battery direct on the line and restoring the same to its normal condition.

The selector battery is opened automatically by restoring the selector (Fig. 3), which is stopped or revolved in unison with all the selectors. When not in use the insulated point *I* rests on the spring *C*, which opens the selector battery at that point; when a station is being selected the point *I* moves around and an electrical contact is made between the disk *M* and the spring *C*. When the restoring battery is thrown on the line the disk *M* is restored to its normal position, its motion being retarded by the escapement *E*, for the purpose of giving the telephone selectors sufficient time to restore themselves before the battery is cut out.

Referring to Fig. 4, the operations on the selector circuit are as follows: The battery connects to a middle spring on the relay line, and when the relay is opened the battery connects through the top spring to the circuit breakers and through it to the line, where it is opened until the selecting key (Fig. 5) is closed, to select a station. When the line relay is dropped by hanging up the receivers, the selector battery then goes through the lower spring of the line relay to the restoring selector, thence out on the line through the disk *M* and spring *C* (Fig. 3), and also through the coils of the restoring selector. When this is done the circuit breaker is not in the circuit, which allows additional current to restore the selectors to their normal position, as may be seen by tracing the circuit through Figs. 3, 4 and 5.

De Veau Telephone Apparatus.

The attention of the telephonic community has of late been very closely riveted upon automatic systems, which are beginning to enjoy great vogue and popularity. The firm of Stanley & Patterson, 93

FIG. 1.—FRONT VIEW AUTOMATIC SWITCHLESS TELEPHONE.

Liberty Street, New York City, already well known as the manufacturers of the De Veau telephone apparatus, has just introduced an ingenious automatic intercommunicating system which is expected to take the place of switch and plug forms in that class of work. The system has been patented recently, and is here illustrated in Figs, 1, 2, 3 and 4. In this system any station may be called by pressing the button, with the receiver on or off the hook. When the receiver is put back on the hook, all connections are automatically restored. By holding down the button on the first call and pressing any of the other buttons, one or more additional parties may be cut in and can take part in the conversation, so that no annoying repetition by a "human repeater" is necessary, and in reality a brisk general conversation can be indulged in. This is a feature of great utility and merit, giving not only greater flexibility to telephone service but saving much time and avoiding many serious mistakes and misunderstandings. It is by such arrangements as this that the telephone best fulfills its function.

Another feature of the De Veau switchless system is that pushing

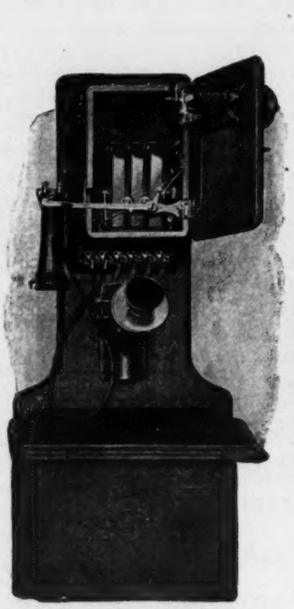


FIG. 2.—STANDARD BRIDGED TYPE LONG-DISTANCE TELEPHONE.

FIG. 3.—AUTOMATIC SWITCHLESS DESK TELEPHONE.

in the button all the way calls the station. When the pressure on the button is removed, it comes back half way and cuts in the talking circuit. All parts of the apparatus are, as usual, made of the best

material with the most careful workmanship, great pains being taken with the constructional details and to avoid intricate working parts, with the result of minimizing liability to interruption of service even with the most bungling and impatient user. The push and switch connection have rubbing contacts. The telephone is wired complete to a hinged back board, so that the line circuits can be connected permanently to the back board, while the interior of the set can be examined or the circuits tested without disconnecting any of the wires.

The De Veau automatic switchless desk set is also shown in Fig. 3. It is a handsome piece of mechanism and will grace any desk, directors' table or other article of that kind. The base is made of cast metal in highly finished and polished nickel, and in it the intercommunicating switchless mechanism is enclosed. Each instrument is fitted with the De Veau solid back Bell type of transmitter and a solid bipolar receiver.

Another recent product is new standard type of Mr. De Veau's long distance and exchange telephone set, fitted with a 25,000-ohm series generator, a solid back Bell type transmitter and a solid bipolar receiver. There are several improvements embodied in this apparatus due to extensive experiments and long experience. In the transmitter the diaphragm is made of aluminum, specially coated to prevent its becoming corroded. The dampening springs are made of tempered steel. The bridge holding the electrodes is made from heavy half-hard brass, ⅛ inch thick and 1 inch wide. This bridge is provided with a bushing or collar, through which the back electrode plunger passes. This collar is provided with a screw, by means of which any adjustment of resistance in the carbon electrode

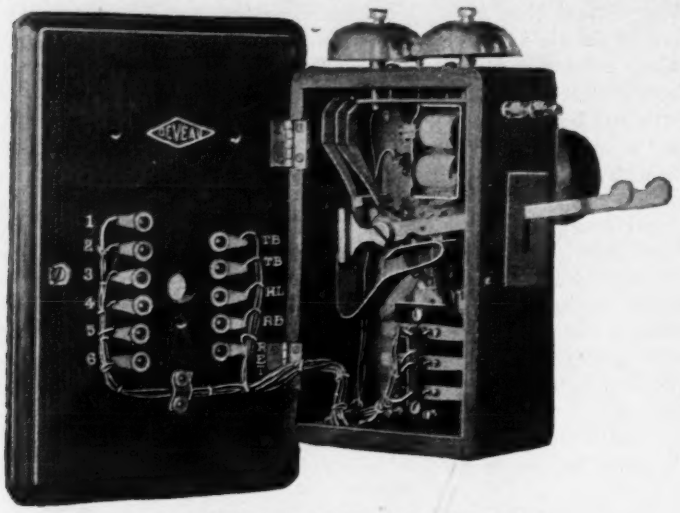


FIG. 4.—INTERIOR OF SWITCHLESS TELEPHONE.

desired may be made, and when properly adjusted, firmly fixed by setting the screw. The front electrode is attached to the diaphragm by a screw and lock-nut. This arrangement allows the electrode to have a lateral as well as a vertical movement, which absolutely prevents the transmitter from packing. The carbon electrodes are fastened to the brass holders by screws, not by solder, as solder is often unreliable because of the acid used, which causes local action and is frequently the source of much annoyance. The carbon electrodes are of carefully tested resistance throughout. The method by which the electrodes are manufactured is entirely original, it is stated. The carbon granules used are prepared in the Stanley & Patterson factory, where they employ a special process, ensuring an exact resistance. The front plate of the transmitter, which supports the parts described above, is made of heavy cast bronze metal, which entirely eliminates the metallic ring so common to transmitter cases when made of spun metal or of a light-weight casting. The mouthpiece is of new type, with perforated guard and vent holes. The vent holes allow a person's breath to escape, thereby preventing the condensation which is so commonly seen on telephone diaphragms.

Apartment House Telephony.

We show herewith the apartment entrance telephone and the telephones for the individual apartment put on the market by the Haines & Noyes Company, of Chicago. The apartment entrance telephone is furnished in connection with letter boxes or without them. These may be either in wood or metal. There is a permanent hook, and the battery circuit is not closed until the receiver is taken off the hook of the individual apartment called. This apartment telephone is furnished with a long-distance microphone transmitter and a bi-polar pony watchcase receiver, with water-shrunk hard rubber shell. The telephone for the apartment is furnished in any kind of wood de-

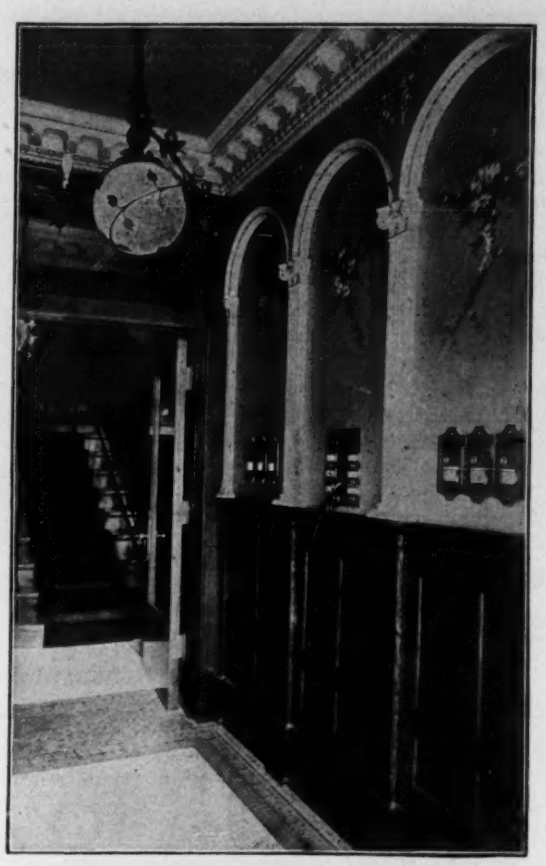


FIG. 1.—APARTMENT HOUSE TELEPHONE.

sired, with buzzer or double gong vibrating bells. It is very small and compact, and the cost of the installation of this system, including telephones and wiring is but a little more than the ordinary speaking

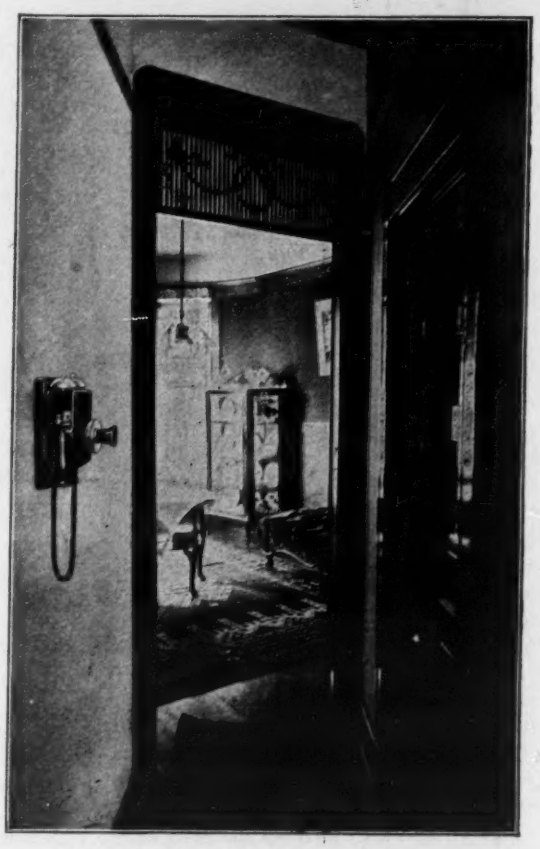


FIG. 2.—APARTMENT HOUSE TELEPHONE.

tube system. If desired, a special apartment annunciator can be used in connection with the above which permits the janitor to connect apartments together.

Two Connecticut Telephones.

The accompanying illustrations, Figs. 1 and 2, show two styles of telephone outfits manufactured by the Connecticut Telephone & Electric Co., Meriden, Conn. The instrument shown in Fig. 1 was designed with the object of producing a compact set, embracing all of the essential parts of a complete magneto call telephone. It is made in three sections, the upper containing the switch hook, induction coil and ringer (the latter being mounted on the cover); the middle section contains the generator and the lower section the necessary battery for operating the transmitter. The lower or battery compartment will hold two dry cells. The entire front of the instrument consists of a lid or cover which can be opened, exposing to view all of the working parts, thus rendering it very convenient to make any changes or repairs. The outfit is supplied with the company's improved form of receiver, long-distance transmitter on adjustable arm and new type of magneto generator, and it can be furnished for both series and bridging lines of any capacity. This instrument is also supplied with a carbon lightning arrester when desired. This is mounted between the binding posts on top.

FIG. 1.—CONNECTICUT TELEPHONE.

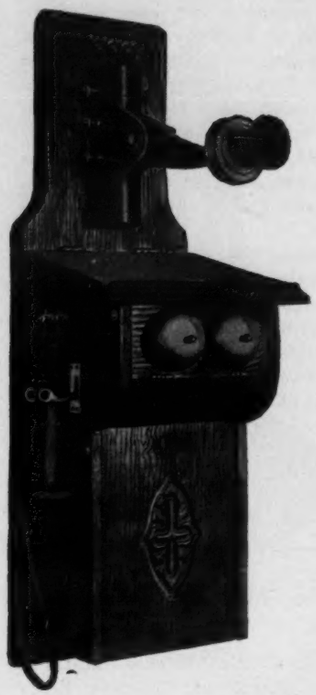


FIG. 2.—CONNECTICUT TELEPHONE.

MOLDED RECEIVER.

The other instrument (Fig. 2) is constructed on the general lines of a central energy instrument, but unlike the latter is made for use on a magneto system. The cabinet is so constructed that the upper lid can be raised; the front, on which are mounted the ringer and gongs, can be lowered or opened, and the battery box is also supplied with a door so that the batteries are accessible. This instrument is supplied with magneto generator, switch hook and ringer and the battery case will hold three cells of dry battery. It is likewise supplied with carbon lightning arrester when so desired. It is especially adapted for residence work on account of its attractive appearance.

Molded Telephone Receiver.

A little over a year ago, a patent was issued to Mr. William J. Murdock on a telephone receiver, in which the parts are molded into the case. The manner of molding is as follows: The magnet, pole pieces, binding posts, connection wires and other necessary parts are placed in a mold and when surrounded by the material, the whole is put under great pressure, making virtually a unity to exist between the metal parts and the case. The fact that these parts are all imbedded in the case makes it obvious that it is impossible for them to work loose or to change their position in any way. When a receiver is made in this manner and once set up, with the pole pieces at a proper distance from the diaphragm, there is no possibility of the receiver losing its adjustment, no chance of the binding posts pulling out, nor of the case breaking, even though it be given the roughest kind of usage.

This receiver, which is called the "Solid," and is made up in different styles, has been on the market now nearly a year, and its manufacturers, William J. Murdock & Co., of Chelsea, Mass., state that it has met with unqualified success. The style shown herewith has the binding posts covered with a cap.

A New Telephone Exchange at Wheeling W. Va.

The National Telephone Company, of West Virginia, which owns an exchange not only in Wheeling but in surrounding towns, and has long-distance connections in western Pennsylvania, Maryland and Ohio, is now putting in a new central energy bridged multiple switchboard of an ultimate capacity of 5040 subscribers' lines. This is one of the new lamp signal boards made by the Stromberg-Carlson Telephone Manufacturing Company, of Chicago. The board is equipped for the present for the operation of 2160 lines. There are 120 subscribers on each operator's position, and 15 pairs of cords and appliances connected therewith at each position. The switchboard is of interest because of several new features embodied in it, one of the most important of which is the busy test. The instant a subscriber takes the receiver from the hook his line will show a busy test at any of the multiple jacks on the board. On many boards, as is well known, there is no means of telling whether a line is busy until connection between the subscribers is established. Differential relays are used in the subscribers' circuits for signaling purposes. An insertion of a plug to answer a call by an operator unbalances a relay to put out the lamp signal. On this board there is a double lamp supervision for each cord inserted. In addition to the regular operator's board in this exchange is a chief operator's desk with complete intercommunicating lines, and one monitor's desk with monitor lamps and supervision apparatus. In the terminal room the main arc is built for 5600 lines on the cable side and 2400 pairs of lightning arresters of the Stromberg-Carlson slate-base, heat-wire type. The intermediate distributing frame is also for 5600 lines. All cables in the switchboard have No. 22 copper wire conductors with silk-cotton insulation. These cables are manufactured by the Stromberg-Carlson Telephone Manufacturing Company.

A 40-volt storage battery is used on the Stromberg-Carlson central energy system. There are two sets of 20 cells each, Chloride accumulators of 640 ampere-hours capacity installed in lead lined

tanks. For charging these, two 5-hp Roth motor-generators are being installed. These receive current at 110 volts and give 60 amperes at 60 volts at the generator terminals. These sets consist of motor and generator on the same base connected by a flexible insulated flange coupling. The ringing is done by a Roth motor-generator receiving 110 volts direct current and generating 100 volts, 20 cycle alternating current. Provision is also made for the supply from an alternating-current lighting circuit of 104 volts, 60 cycles. The motor-generator for this consists of an Emerson single-phase motor direct connected to a ringing generator giving 100 volts at 20 cycles. To supply a ringing current from the storage batteries in case all others fail, a Roth motor-generator will receive current at 40 volts and deliver at 100 volts alternating current. The power board, which is white marble, is equipped with Weston ammeters and voltmeters, I. T. E. underload and overload circuit breakers, together with the necessary single and double-pole switches, fuse links and rheostats.

To handle the extensive long-distance business, a three-position toll board is being put in. This company also has branch exchanges at Pleasant Valley, Benwood, Barnesville and Bridgeport. On the main board at Wheeling are five operators' positions for taking care of incoming trunk circuits. These trunk circuits terminate directly in plugs, so that when one of the trunk circuit operators receives an order, she has simply to connect a plug on the proper trunk line to the subscriber's jack on the board in front of her. The branch exchange at Pleasant Valley is a 400-line trunking lamp signal board; that at Benwood is a 280-line board of the same kind; at Barnesville a 280-line board, and at Bridgeport one of 250 lines.

New Motors for Sewing Machine Work.

The accompanying illustration shows some of the new features of the iron-clad motors of the Diehl Manufacturing Company, Elizabethport, N. J., and their application to different types of machines. This type of motor for operating sewing machines and other special use has attained great popularity on account of its high efficiency and durability. Iron-clad armature, silk insulation on armature wire, hard-drawn copper commutator bars, self-aligning and self-oiling

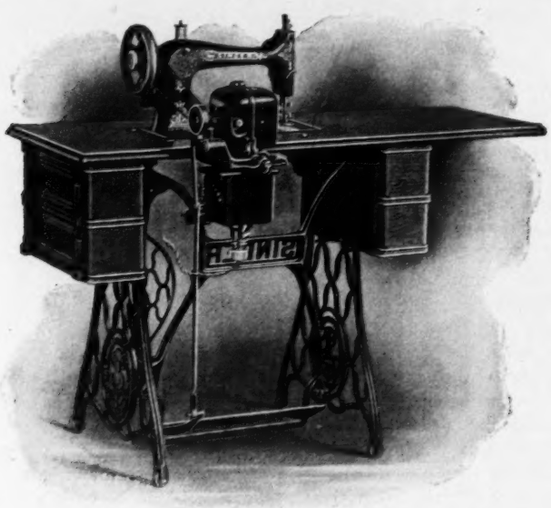


FIG. 1.—SEWING-MACHINE MOTOR.

bronze bearings are prominent features. Fig. 1 shows the motor with brake attachment and speed regulator supported by an iron bracket, with belt tightener. Different speeds are obtained by pressing the treadle downward, and the current is automatically cut off and the machine instantly stopped by removing the pressure from the treadle. There are different styles of brackets for any make of family or manufacturing machine.

Fig. 2 shows an ingenious arrangement by which the motor with brake attachment and speed regulator can be applied to a drop-head machine without any changes being made on the machine except to remove the band wheel from the stand. An idler with a gravity catch and belt tightener is included in this outfit. The idler guides the belt

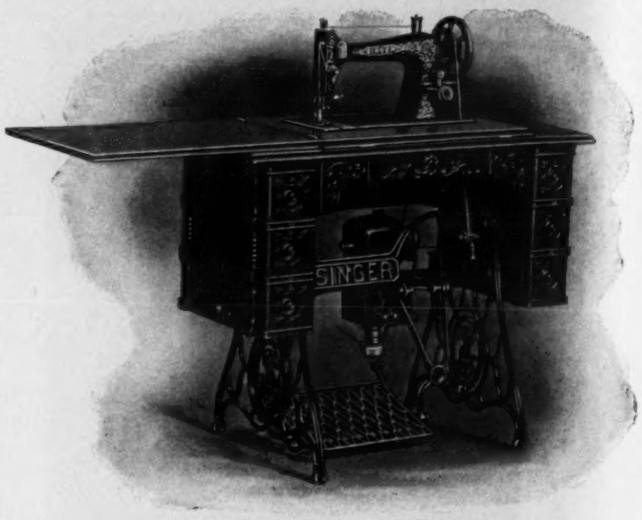


FIG. 2.—SEWING-MACHINE MOTOR.

through the holes in the lifting plate, and the gravity catch releases the belt when the machine head is lowered into the cabinet.

New Vertical Spindle Milling Head.

We show herewith a half-tone and sectional view of a new vertical spindle milling head for use on heavy-knee types of milling machines, the former showing the head attached to a machine, and the latter, which is a section on a vertical plane through the horizontal and vertical spindles, indicating the construction and size. Although the views are self-explanatory, a word relative to method of adjusting the spindle may not be out of place.

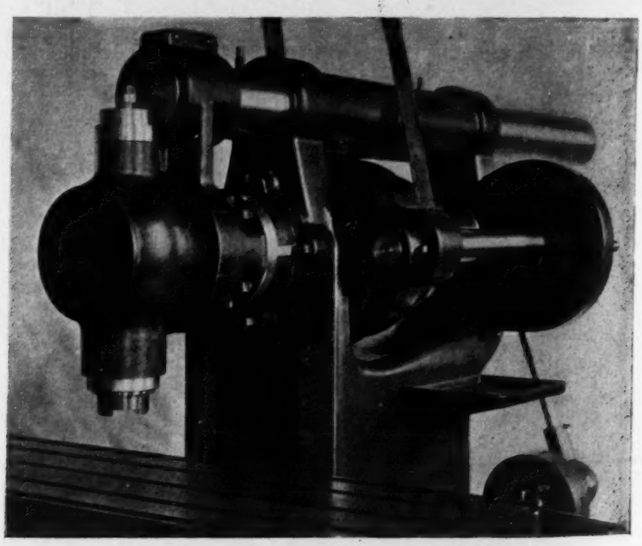


FIG. 1.—VERTICAL MILLING HEAD.

The spindle is taper at its lower end, where it runs in a babbitted bearing, and is adjusted to this bearing by means of a lock nut on its upper end. The upper box is bronze, split, and taper on its outside. It is adjusted to the end of the spindle by means of the lock nut on the box. This method of adjustment is the same as that used on the horizontal spindle of the machine. The head can be swiveled in a vertical plane through 360 degs. The circle bearing the graduation is divided into degrees and is 8⅝ inches in diameter, which size is important in that it brings the graduations far apart. A notable feature is the method of securing the cutter shanks in the spindle. The

cutter shanks form the male part of a clutch, of which the spindle is the female, this taking the place of the usual tang on the end of the shanks. In this case the ends of the shanks are tapped ⅝ to 11, to fit the bolt shown, and by which they are firmly secured. The bolt is provided with a shoulder near its head, so it can be used for backing a shank out as well as for drawing it in.

The end of the spindle is threaded on the outside, as in the case of the end of the horizontal spindle of the machine, and both spindles have the same size taper hole so that all tools are interchangeable between the two spindles. With this attachment the horizontal spin-

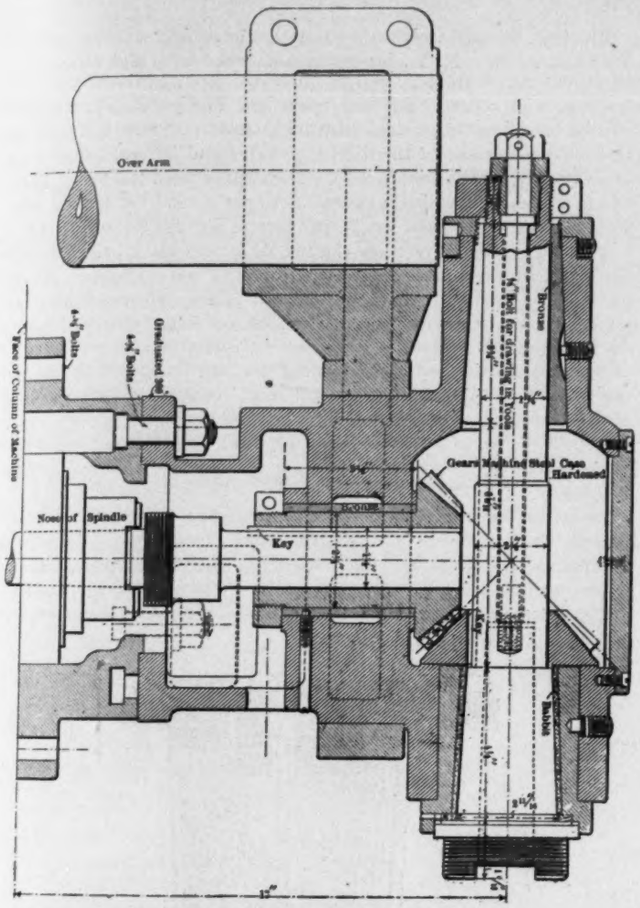


FIG. 2.—SECTION OF VERTICAL MILLING HEAD.

dle miller is readily converted into a vertical spindle miller, capable of doing heavy work, thus embodying in one machine the advantages of both. It will work a 6-inch diameter face mill in cast iron.

When there is occasion to change cutters while the work is chucked on the machine, the head can be swung at an angle, and the operator has all the room he wants for making the change. This obviates the awkward position which so often arises from a lack of room for changing cutters on the usual vertical spindle miller. This attachment is made by the Cincinnati Milling Machine Company, and is especially designed for use on their No. 3 and No. 4 machines.

An Improved Telephone Receiver.

An improvement in telephone receiver construction is shown in the accompanying illustrations, Fig. 1 being a view of a receiver with its case removed, and Fig. 2 the receiver complete.

The absence of binding posts at the end of the instrument is the first thing to attract attention. As will be seen in Fig. 1 the connections are made inside of the instrument, and are independent of the case. It is evident, therefore, that if the shell is damaged or broken by accident it does not necessarily impair the operation of the instrument. The insulation of the connecting cord, it will be noticed, is continuous up to the point of connection with the magnet terminal wires. The case, therefore, is simply a protection for the operative parts of the instrument, just as a watch case is a protection for the works of a watch.

The Russell-Tomlinson Electric Company, of Danbury, Conn., the manufacturer, calls attention to several points in favor of this telephone, among which may be mentioned its immunity from any disorders due to atmospheric changes on account of its being made entirely of metal; absence of binding posts, which are prone to work loose and harbor loose connections; the working parts are screwed

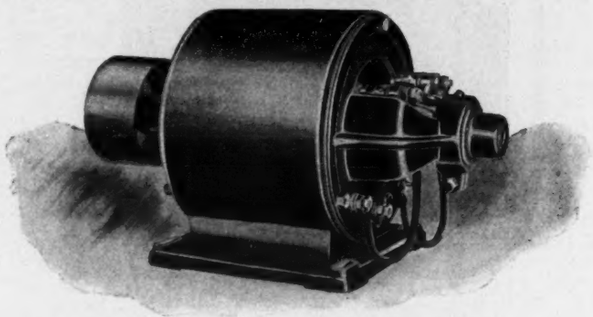
FIGS. 1 AND 2.—TELEPHONE RECEIVER.

into the shell, and when the cap is in position it becomes a check nut, thereby rigidly holding the parts in the case, and, finally, the fact that the entire removal of the shell does not impair the usefulness of the instrument.

Shielded Type Motors.

The accompanying illustration shows a shielded type of direct-current motor manufactured by the Sterling Electric Motor Company, Dayton, O. This motor is wound for 110, 220 and 500 volts, and develops ½ hp at medium speed, ¼ hp at slow speed, and ⅛ hp at very slow speed. It embodies new magnetic, electrical and mechanical features, each of which, it is stated, contribute to the efficiency of the machine. The armature is built up of stampings from specially prepared steel sheets, the conducting wires being held in place in the slots by strips of bamboo. The company calls attention to the yoke of this machine, which is made of a special iron very dense and of even composition, and has a very high permeability.

The commutator is of the standard design and construction, and the brushes used are of high-grade carbon or graphite, rectangular



SHIELDED TYPE MOTOR.

in form, and have a universal adjustment by means of the brush holder.

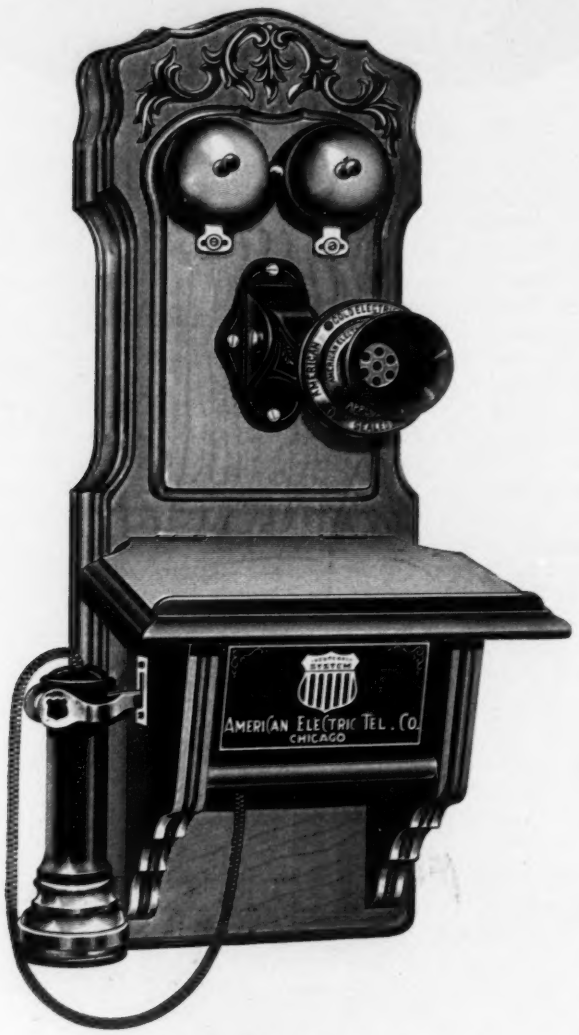
These motors may be fastened to a column, side wall or suspended from a ceiling, the turning of the journals in their seats being the only necessary adjustment in case of a change. It is stated that these machines run with almost entire absence of noise and are so well constructed mechanically that there is practically no vibration when the machines are in operation.

New "American" Telephone Apparatus.

One of the latest types of telephone apparatus made by the American Electric Telephone Company is shown herewith. In designing this set it was the purpose to produce an instrument that would, by means of a superior form of construction, overcome a number of objectionable features. The switch-hook is accessible by lifting up the cover which at the same time forms a writing tablet support. For a ready examination of the signal bell and condenser, the removing of a screw permits the swinging outward of that part of the telephone which contains the signal bell, switch-hook, the writnig tablet and the transmitter with its supporting arm. The swingable portion is hinged to a back board containing the condenser, the lightning arrester and line connecting terminals. Thus with the telephone cabinet opened up we have the condenser, line terminal and lightning arrester accessible as well as the signal bells.

All the wires and connections required for interconnecting all of the elements contained in the telephone are exposed for the purpose of inspection or repairs. All the parts have been symmetrically designed, and the lightning arrester, the switch-hook, the telephone receiver, the signal bell are of high grade and efficient construction.

In the design and construction of the new long lever automatic switch-hook, several novel features have been incorporated. The hook is self-contained, the working parts being mounted on a solid



A RECENT TYPE OF TELEPHONE.

casting. There is no electrical connection through the lever joint, the main spring acting as a switching device. All contact points are platinum tipped, ensuring freedom from bad connections or poor contact.

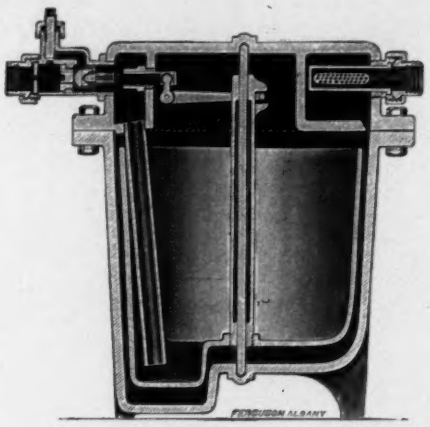
The gold electrode transmitter applied to this telephone is an interesting device, the object being to produce a transmitter that is extremely sensitive, and at the same time one that would give clear and perfect articulation, with sufficient power to insure successful conversation over lines of either extremely high resistance or those having a combination of high resistance and a large number of bells bridged across the lines. The diaphragm proper is of metal, having its inner bearing on springs and held in such a way that the entire surface is vibrated instead of the vibration radiating from the center, as in the case where the diaphragm is firmly clamped at its edges. The shell or casting is made of material with sufficient weight to prevent vibration taking place anywhere, excepting at the diaphragm.

High Pressure Non-Return Steam Trap.

The trap shown herewith has been designed by the Albany Steam Trap Co., Albany, N. Y., for use in connection with high-steam pressures and differs materially from the usual type of non-return steam trap, both in construction and operation. The great difficulty with non-return steam traps used with high-steam pressure, has been the rapid wearing away of the discharge valve and its seats, due to the great velocity of the condensed water escaping from the trap cylinder to the atmosphere, which is about 120 ft. per second for 100 lbs. pressure, increasing to about 140 ft. per second for 150 lbs. pressure.

This high velocity requires the use of a very small orifice for the discharge of the condensed water from the trap cylinder. A trap having a capacity for handling, say, 10 gallons of water a minute working under from 100 to 150 or 160 lbs. pressure, needs not have a discharge opening greater than from one-eighth to three-sixteenths of an inch in diameter. In designing the trap illustrated the advantage of the velocity in discharging a large quantity of water through a small opening, is availed of and forms an important feature of the trap. At the same time the discharge valve proper of a trap of this size, instead of being small, is fully three-quarters of an inch in diameter.

Inside of the trap case or shell, is contained a movable open top bucket which operates the discharge valve. This is so operated that it remains on its seat until the bucket has filled with water, when it drops through several inches of space to the bottom of the trap case, and in dropping opens or removes the discharge valve from its seat



STEAM TRAP.

fully three-eighths of an inch. Were it attempted to leave this three-quarters of an inch opening free for the escape of the water to the atmosphere with the great pressure of steam in the trap, the latter could be emptied of the remaining water in about 3 seconds, when it would blow steam until such time as the bucket could be floated high enough to close the valve. This, however, is prevented by placing in the discharge pipe or valve case proper, a thin disk of metal having in it a hole of one-eighth or three-sixteenths diameter, through which the water much escape before reaching the atmosphere, thus insuring time for the bucket to rise and close the discharge valve.

It will readily be seen that the advantage of this construction and operation is two fold. First, the wear caused by the great velocity of the water escaping to the atmosphere is not on the valve proper, but in the small metal disk, and this disk can be removed and renewed in a few minutes' time at a slight cost. Second, the velocity through the valve opening is reduced to about one-fortieth less than it would be with the small opening, or where the discharge valves are gradually opened enough to allow the gradual escape of the condensed water. It follows that the discharge valve in this trap working under the conditions described should remain in good condition 40 times longer than the ordinary valve working under ordinary circumstances.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money on call closed at 4 per cent nominal, and time money at 4 per cent for 60 to 90 days; 4¼ per cent for four months and 4¼ or 4½ for five and six months. In the main, there was a strong tone in the stock market in spite of a certain amount of irregularity in its movements. The unsteadiness of Amalgamated Copper shares was the only decided bearish manifestation, but the general market was not affected by it. The traction stocks were a leading feature, Manhattan making a new record by advancing to 138½. Metropolitan also held strong, but Brooklyn Rapid Transit was neglected and irregular, with a downward tendency. Eighty-eight thousand four hundred and fifty shares of Brooklyn Rapid Transit changed hands during the week at prices ranging between 63½ and 68½, the closing price being 64, a net loss of 3½ points. Manhattan Street Railway closed at 166⅛, representing a net loss of 2⅞ points on the week's transactions, which aggregated 21,700 shares. General Electric was the feature of the electric securities, and this stock was active, the sales amounting to 15,000 shares. The closing price was 277½, which was 14½ points higher than our last previous quotation, the range for the week being between 264 and 281½. Western Union, on a fair business, kept within a narrow margin of prices, closing at 91½, a net gain of ⅛ point. One hundred shares of Commercial Cable was sold during the week, the closing price being 183, which is a net gain of 1¾ points over the last quotation. Following are the closing quotations of Tuesday, Dec. 3:

NEW YORK.

	Nov. 26.	Dec. 3.		Nov. 26.	Dec. 3.
American Tel. & Cable..	—	—	General Electric.....	274	276¼
American Dist. Tel.....	—	—	General Carriage.....	⅜	1
Brooklyn Rapid Transit..	67½	63	Hudson River Tel.....	112	112
Ches. & Pot. Telephone..	—	67	Illinois Elec. Veh. Trans.	—	—
Commercial Cable.....	—	—	Metropolitan Street Ry...	167¾	164⅛
Electric Boat.....	20½	19	N. E. Elec. Veh. Tran....	—	—
Electric Boat pfd.....	47	45	N. Y. Elec. Veh. Tran...	9¼	11
Electric Lead Reduc'n...	2	1⅞	N. Y. & N. J. Tel.....	166	167
Electric Vehicle.....	2	2¾	Tel. & Tel. Co. of Am...	—	—
Electric Vehicle pfd.....	4¼	5	Western Union Tel.....	91⅜	91⅛

BOSTON.

	Nov. 26.	Dec. 3.		Nov. 26.	Dec. 3.
Am. Tel. & Tel.....	160	160	Mexican Telephone.....	2	2
Cumberland Telephone...	—	—	New England Telephone.	—	133*
Boston Electric Light....	—	—	Westinghouse Elec.....	—	—
Erie Telephone.....	24	16	Westinghouse Elec. pfd..	—	—
General Electric pfd.....	—	—			

PHILADELPHIA.

	Nov. 26.	Dec. 3.		Nov. 26.	Dec. 3.
American Railways.....	45½	44⅜	Phila. Traction.....	97½	97½
Electric Storage Battery..	58	64	Philadelphia Electric.....	5	4¾
Elec. Storage Batt'y pfd..	58	64	Pa. Electric Vehicle.....	¾	¾
Elec. Co. of America.....	6½	6⅜	Pa. Elec. Veh. pfd.....	1	1

CHICAGO.

	Nov. 26.	Dec. 3.		Nov. 26.	Dec. 3.
Central Union Telephone	—	—	National Carbon pfd.....	83	83
Chicago Edison.....	155	160	Northwest Elev. com....	36	—
Chicago City Ry.....	188	185	Union Traction.....	11⅜	—
Chicago Telep. Co.....	225*	—	Union Traction pfd.....	47¼	—
National Carbon.....	19½	19			

*Asked.

SEATTLE ELECTRIC REORGANIZATION.—The Seattle Electric Company is capitalized for $4,518,000 5 per cent bonds, $1,750,000 6 per cent non-cumulative preferred stock and $5,000,000 common stock and representing this capitalization the company has about 70 miles of electric road—a consolidation of several companies—and an electric light and power plant. About one-third of the earnings are derived from the electric lighting plant and two-thirds from the railroad properties. The city of Seattle is showing an increase in population between 20 and 30 per cent for the past few years. This has naturally been reflected in the earnings of the Seattle Electric Company. The company began the payment of dividends on its preferred stock this spring, 1½ per cent having been paid in April and 3 per cent in October, and the management sees no reason why this 6 per cent rate cannot be indefinitely maintained. The company is just beginning to receive the benefits through reduced operating expenses. While the properties were passing through the transition period expenses were abnormally high. The company owns a valuable coal mine within 15 miles of Seattle, which assures a cheap fuel supply. The stock of the Seattle Electric Company is mostly owned in Boston, principally in large blocks. Messrs. Stone & Webster are the general managers of the company.

GENERAL ELECTRIC PROSPERITY.—The General Electric Comapny has made a remarkable record of earnings the past few years, as the following figures will show, but never before in its history has it been able to show earnings of $1,000,000 net per month, as it did in October, and promises to do in November and December. Its earnings since 1898 have been as follows:

Year.	Gross.	Net.	Surplus after charges.
1898.....	$13,045,098	$2,148,520	$1,815,185
1899.....	17,260,858	4,166,324	3,876,324
1900.....	24,406,068	5,479,131	5,197,464
1901.....	29,829,652	6,243,792	6,167,092

For the year to end Jan. 31, 1902, the company will show net earnings in excess of $8,000,000. When the company is able to restore its capital next April to $42,000,000 it is believed that the management will immediately place the stock on a 10 per cent dividend basis. Net earnings of $8,000,000 per annum would amount to about 20 per cent on $42,000,000 of capital.

INDEPENDENT TELEPHONY AT TRENTON, N. J.—The plant and franchise of the Home Telephone Company (independent), of Trenton, N. J., which furnished local service at considerably lower rates than those charged by the Bell Company, have been sold at auction under foreclosure for $20,000. After the foreclosure and receivership expenses have been paid, bondholders can hardly expect to receive more than from 5 to 10 per cent upon the par value of their holdings. The company was organized something less than five years ago, when $300,000 in equal amounts of first mortgage bonds and capital stock were issued and sold to local investors. For the first year it was claimed that the company was making money and in a prosperous condition. At the end of that time, however, it found its earnings were not sufficient to pay its expenses, and was forced to borrow money from time to time to make up the deficiency. For the past two years no interest has been paid on the bonds, and the bondholders finally foreclosed and had a receiver appointed and the property sold with the above result.

NEW YORK STATE TROLLEYS.—A certificate of consolidation of the Utica Belt Line Street Railroad Company and the Utica & Mohawk Railroad Company, forming the Utica & Mohawk Valley Railway Company, has been filed with the Secretary of State. Capital, $461,237.50. Directors: L. B. Grant, Charles V. Nellsay, Charles C. Clark, John T. Wells and Henry L. Merry, of Brooklyn, and Richard T. McKinvy, Ashley T. Cole, Charles H. Warner and William J. Bagnell, of New York City. The Kingston Consolidated Railroad Company has received the consent of the State Board of Railroad Commissioners to the issuance of a mortgage for $700,000 and for an increase in its capital stock from $250,000 to $400,000. The company merged the former Colonial Traction Company, of Kingston, and will employ the increased capital in the purchase of the Kingston City Road, and for new construction.

CINCINNATI GAS & ELECTRIC.—The stockholders of the Cincinnati Gas & Electric Company will vote Jan. 8, 1902, upon a proposal to increase the capital stock of the company from $28,000,000 to $29,000,000. The stock is to be retained in the treasury and only to be sold at the market price when necessities for increase may arise. The extensions of the company during the past six months have been enormous. This increase is more or less a surprise, though the large buildings, the additions to the plant, the replacing of the overhead wires by the underground system and the large extensions to the electrical plants, made the matter of more stock but a question of time. The company was organized in the spring and was the result of the consolidation of the Cincinnati Gas Light & Coke Company, and the Cincinnati Edison Electric Company, absorbing every electric lighting station in the city.

GENERAL CARRIAGE COMPANY.—General Carriage stock has been active on the New York curb, advancing from ⅜ to ½ on sales of around 2000 shares. As previously announced, a new company is to be formed with total authorized capital of $2,000,000, consisting of 40,000 shares of $50 par value each, and it will issue $500,000 5 per cent debenture bonds, of which $400,000 will be sold at par to provide the means of putting the company into active business in New York City.

DIVIDENDS.—The directors of the American District Telegraph Company, of Brooklyn, have declared the usual semi-annual dividend of 3½ per cent, payable Dec. 10. Directors of the Massachusetts Electric Companies have declared the regular semi-annual dividend of $2, payable Jan. 1 to stockholders of record Dec. 10.

CANTON-MASSILLON TROLLEY.—The Elkins-Widener syndicate has purchased the Canton-Massillon Electric Railway property, paying $1,250,000. It is 13 miles long. The Canton electric plant was purchased some time ago.

Commercial Intelligence.

THE WEEK IN TRADE.—Favorable reports were made through the mercantile agencies during the past week from most all sections. The needed stimulus to retail and holiday demand in the North, East and portions of the South seems to have come with the advent of more seasonable weather. The great basic conditions of wholesale trade and industry, however, show no particular change, though in iron and steel the situation is apparently further strengthening the position of producers. There has been no perceptible change in the car shortage situation; indeed, it has been aggravated somewhat by the switchmen's strikes at several points. A number of furnaces in the Pittsburg district are banked and several mills are idle from lack of supplies. In finished products, bars, sheets and structural material are all active. It is stated that the big steel interests have plenty of cars, but not enough power to move them. The buying of railway supplies is the most urgent feature of the market, rails, cars, engines, structural material for bridges and shop equipments all being wanted much earlier than they can be delivered. In general lines the movement is scarcely less active, and despite the vigorous prosecution of work since the end of the big strike, there is no evidence that mills have gained on their orders. In the copper market there were rumors of a prospective cut in the prices, but these proved to be unfounded up to the close of the week. Owing to the depreciation of the principal copper stock, interest in the copper situation has become more acute, but as to active trade conditions the situation is unchanged. The prices remain practically unchanged at 16¾c. for Lake, 16.30c. to 16⅝c. for electrolytic, and 15⅝c. to 16⅝c. for casting stock. The number of business failures last week, according to *Bradstreet's*, aggregated 189, as against 225 the previous week and 184 the corresponding week last year.

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material, machinery, etc., from the port of New York for the week ended Nov. 27: Antwerp—15 pkgs. material, $616; 31 pkgs. machinery, $3,132. Argentine Republic—111 pkgs. material, $2,954. Bristol—26 pkgs. machinery, $7,710. Brazil—65 pkgs. machinery, $7,840; 85 pkgs. material, $517. British Guiana—18 pkgs. material, $583; 50 pkgs. wire, $95. Bordeaux—1 pkg. material, $50. Bilboa—1 pkg. electrical material, $50. Birkenhead—22 pkgs. wire, $1,242. British East Indies—6 pkgs. material, $230. Bolivia—2 pkgs. material, $96. British West Indies—17 pkgs. material, $424; 6 pkgs. wire, $26; 5 pkgs. motors and parts, $927. British Possessions in Africa—80 pkgs. material, $4,465; 1 pkg. wiring machinery, $396. Cardiff—25 pkgs. wire, $1,391. Central America—4 pkgs. material, $185. Cuba—1 pkg. machinery, $100; 177 pkgs. material, $6,976. Chili—66 pkgs. material, $150; 16 pkgs. machinery, $150. Glasgow—15 pkgs. machinery, $895; 37 pkgs. wire, $2,671; 10 pkgs. material, $427. Genoa—5 pkgs. material, $500. Havre—5 pkgs. material, $131; 1 pkg. machinery, $45. Hamburg—3 pkgs. machinery, $229; 57 pkgs. material, $2,077; 291,610 lbs. copper, $47,859. Hull—15 pkgs. machinery, $21,048. Ipswich—12 pkgs. wire, $491. Japan—3 pkgs. machinery, $1,320; 34 pkgs. material, $5,384. Leeds—1 pkg. material, $250. Liverpool—188 pkgs. machinery, $10,409; 40 pkgs. material, $2,669; 561,230 lbs. copper, $93,728; 76 pkgs. wire, $1,305. London—348 pkgs. material, $12,585; 91 pkgs. machinery, $3,854. Leicester—7 pkgs. machinery, $210. Manchester—10 pkgs. material, $190; 104 pkgs. machinery, $14,015; 448,208 lbs. copper, $74,000. Mexico—32 pkgs. material, $984; 44 pkgs. machinery, $4,000; 50 pkgs. wire, $1,000. New Castle—14 pkgs. machinery, $1,993. Nice—2 pkgs. material, $200. Odessa—106 pkgs. agricultural implements, $1,600. Philippines—25 pkgs. material, $1,403. Peru—34 pkgs. material, $461; 20 pkgs. copper wire, $750. Rome—6 pkgs. material, $500. Rotterdam—2 pkgs. machinery, $135. San Domingo—71 pkgs. material, $420. St. Petersburg—1 pkg. material, $24. Southampton—3 pkgs., material, $93. U. S. Colombia—5 pkgs. material, $126. Venezuela—17 pkgs. material, $269. Vienna—21 pkgs. machinery, $860.

THE CROCKER-WHEELER COMPANY, of Ampere, N. J., is being pushed to the utmost to keep up with the large number of orders it is daily receiving and has on hand. It is constantly adding to the number of factory hands, and has for some months been working a regular night shift. Among shipments made during the last month are two 520-kw generators for the American Smelting & Refining Company, Perth Amboy, N. J.; three 400 kw and one 100 kw for the Alsen Cement Plant, West Camp, N. Y.; one 400-kw generator for the Christensen Engineering Company, Milwaukee, Wis.; one 300-kw generator for the Balbach Smelting & Refining Company, Newark, N. J.; three 200-kw generators for the Stetson & Co.'s new power plant, Philadelphia; one 375-kw generator for the Anglo-American Provision Company, Chicago; one 400 kw and one 75 kw for the Lake Shore & Michigan Southern Railroad; one 200-kw generator for the Vandergrift Construction Company for railroad work; one 200-kw generator for the Crucible Steel Company, of Blair, Pa.; one 150-kw generator for Latrobe Steel Company; one 200 kw for the Otis Elevator Company and one 100-kw generator for the United States Tube Company. The company has also completed the entire shipment of the 45-kw direct-connected generator, and 50 or 60 motors for the Government Printing Office in Manila, Philippine Islands. Among the orders recently received are noted the following: Two 300-kw generators for the Singer Manufacturing Company, South Bend, Ind.; two 200-kw belted generators for Sayre & Fisher, Sayreville, N. J.; one 60 and one 30-kw generator for the Orange Brewing Company, with various motors ranging from 35 to 2 hp in capacity; four 140-kw generators for the Fort Hill Chemical Company, Rumford Falls, Me.; two 75-kw generators for Henry Lang & Co., Newark, N. J.; one 90-kw generator for the United States Electric Lighting Company, Washington, D. C. Shipments of 13 motor-dynamos for the Western Union Telegraph Company's new office at Milwaukee, and the electrical equipment of Skinner & Sethman Publishing Company's plant, Denver, Colo., consisting of a 40-kw generator and 28 motors will also be made immediately.

EXPORTATION OF MANUFACTURES from the United States continues to show a healthy growth in nearly all important articles, except copper and iron and steel. The export figures just made public by the Treasury Bureau of Statistics show that in the ten months ending with October, exports of copper have fallen about $23,000,000, and of iron and steel about $23,000,000, making a total reduction in these two classes of $46,445,685. The total reduction in exports of manufactures of all kinds during the same time is only $44,162,856, thus showing an increase in the exportation of manufactures as a whole, exclusive of these two articles, copper and iron and steel. The value of copper exports in the ten months ending with October is 45½ per cent below that for the corresponding months of the preceding year, and the value of iron and steel exports is 21½ per cent below that for the corresponding months of last year. In the other manufactures, taking the entire group, except copper and iron and steel, there is, as already indicated, an actual increase. In the case of iron and steel the reduction is partly due to reduced prices per unit of quantity, in part to a reduced demand abroad, and in part to forced sales at low rates in certain foreign countries. In copper the reduction is not due to reduced prices, the average value per pound of the copper exports of the ten months of this year being the same as that of the corresponding months of last year, viz., 16.3 per cent per pound. The reduction in copper, therefore, is in quantity, the exportation of ingots, bars and plates falling from 300,160,141 lbs. in the ten months of 1900 to 162,728,397 lbs. in the corresponding months of 1901. This falling off in the case of copper is due in part to a reduced demand in the European countries which were the chief foreign market for American copper, and in part to an increased production in other countries and reduction of prices by foreign producers. The only other important article showing a material reduction is mineral oil, which is about $3,000,000 less than in the corresponding months of last year, but this decrease is solely due to reduced prices,

THE HAINES & NOYES COMPANY, manufacturer of telephone apparatus for every possible use, 118-132 West Jackson Boulevard, Chicago, has during the past month closed the following large contracts through its private telephone plant department: The Manistee Iron Works, Manistee, Mich.; Story & Clark Piano Company, Grand Haven, Mich.; David C. Cook Publishing Company, Elgin, Ill.; College of Physicians and Surgeons, Chicago; Rush Medical College, Chicago; Wesley Hospital, Chicago; Evanston Hospital, Evanston, Ill.; St. Anne's Hospital, Chicago; Elmes Engineering Works, Chicago; Tampa Electric Company, Tampa, Fla., Electric Railway Telephone Equipment; Houghton County Street Railway Company, Hancock, Mich.; Blue Hill Street Railway Company, Milton, Mass. It has also supplied Armour & Co., of Chicago, with a large outfit of telephones, besides replacing a number of telephones that were formerly used there. Through agents the Haines & Noyes Company has also equipped a large number of business houses in Lynn, Mass.; Philadelphia, Pittsburg, Louisville, Boston, Kansas City, St. Paul, San Francisco, Los Angeles, etc. Besides these plants, this company has equipped a number of private residences with telephone systems, as well as numerous apartment buildings throughout the United States.

THE ARROWSMITH ELECTRIC CO., LTD., Reading, Pa., a large electrical construction company, has opened a branch house at Harrisburg for the purpose of facilitating its growing business in central Pennsylvania. Its working force is strong. C. H. Hill, formerly of the Prismatic Electric Sign Company, of Syracuse, N. Y., has assumed the local management, with Maxwell H. Hite as assistant and foreman of construction and repairs. The office, wholesale and retail departments are looked after by Eugene Gallagher, formerly of the Prismatic Electric Sign Company. The company reports good business and bright prospects, and is working its facilities day and night to keep pace with orders. Mr. A. V. Arrowsmith visited New York recently, where he purchased a large line of electrical supplies and novelties for the Harrisburg and other branches of the concern.

RECIPROCITY—President Roosevelt, in his message to Congress, approves the general acquiescence in the present tariff as "the first requisite to our prosperity," and adds: "Yet it is not only possible but eminently desirable to combine with the stability of our economic system a supplementary system of reciprocal benefit and obligation with other nations. Such reciprocity is an incident and result of the firm establishment and preservation of our present economic policy. It was specially provided for in the present tariff law. Reciprocity must be treated as the handmaiden of protection. Our first duty is to see that the protection granted by the tariff in every case where it is needed is maintained, and that reciprocity be sought for so far as it can safely be done without injury to our home industries. Just how far this is must be determined according to the individual case, remembering always that every application of our tariff policy to meet our shifting national needs must be conditioned upon the cardinal fact that the duties must never be reduced below the point that will cover the difference between the labor cost here and abroad. The well-being of the wage-worker is a prime consideration of our entire policy of economic legislation. Subject to this proviso of the proper protection necessary to our industrial well-being at home, the principle of reciprocity must command our hearty support. The phenomenal growth of our export trade emphasizes the urgency of the need for wider markets and for a liberal policy in dealing with foreign nations. Whatever is merely petty and vexatious in the way of trade restrictions should be avoided. The customers to whom we dispose of our surplus products in the long run, directly or indirectly, purchase those surplus products by giving us something in return. Their ability to purchase our products should, as far as possible, be secured by so arranging our tariff as to enable us to take from them those products which we can use without harm to our own industries and labor, or the use of which will be of marked benefit to us.

TRADE WITH JAPAN.—The annual return of the foreign trade of the Empire of Japan for the year 1900, which has just reached the Treasury Bureau of Statistics, shows that the growth in American imports into Japan during the decade has been far greater than that of any other nation. The total value of imports from the United States into Japan in 1900 was, according to this official publication of the Japanese Government, 62,761,196 yen, against 6,874,531 in 1890, being thus nearly ten times as much in 1900 as in 1890. That this growth of imports from the United States has been far in excess of that of other countries, or of that of the average, is shown by the fact that the total imports of Japan are but 3½ times as much in 1900 as in 1890, while those from the United States are, as already indicated, nearly ten times as much in 1900 as in 1890. The total imports of Japan in 1900 are 287,261,845 yen, against 80,554,874 in 1890. Comparing the growth in the imports from the United States with those from other countries, the gains from the United States are equally apparent. The imports from Germany increased from 6,856,955 yen in 1890 to 29,199,695 in 1900, the figures for 1890 being almost identical with those of the United States, while in 1900 they are less than half of those of the United States. From Great Britain the imports in 1890 were 26,619,102 yen, and in 1900 71,638,219, having thus been four times as much as those from the United States in 1890, while in 1900 they exceeded those from the United States by about 15 per cent only.

WATER POWER DEVELOPMENT IN MICHIGAN.—A project is on foot to furnish to the manufacturing plants of Grand Rapids, Mich., electric power generated at the rapids in Muskegon River, half way between Muskegon and Big Rapids. The Higginbothams, of Chicago, control or own practically all of the rights on Muskegon River between the two cities named. It is understood that the Edison Light Company, of Grand Rapids, has been approached with an offer to enter into an arrangement in this connection. The Edison company now controls the field in Grand Rapids, having recently absorbed the Grand Rapids Electric Light & Power Company by purchase. It is not the idea of the Higginbothams to compete with the Edison company, but rather to secure the co-operation of the company. There is a large amount of available water power in the river at the point referred to, which is about 40 miles from the city, and a small part of it is now used to supply power to manufacturing industries in Newaygo. There appears to be no question at all about the feasibility of the plan, and it will undoubtedly be put through in one form or another provided the city is able to care for the enterprise to a sufficient extent to make the investment pay.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY.—Harry Shafer, formerly manager of the Stromberg-Carlson Telephone Manufacturing Company, has severed his connection with that company to organize a new telephone manufacturing and construction company to be known as the International Telephone Manufacturing Company. The factory, which is at Harrison and Clinton streets in Chicago, is being fitted out with up-to-date machine tools, and the new company will make all kinds of telephones and switchboards for both public and private exchanges. Mr. Shafer is president of the company. W. E. McCormick, the vice-president, who will have charge of manufacturing, is the inventor of the numerous new features upon which patents have been allowed, and which will be incorporated in the apparatus produced. Mr. McCormick is an old Bell man. John C. Burmeister is secretary, and D. A. Clithere counsel. The factory is starting at present writing, and will soon be in full swing.

EQUIPMENT AND SUPPLIES FOR FAR EAST.—The American electrical engineering and contracting firm of Bagnall & Hilles, Yokohama, Manila and Singapore, continue to place fair-sized contracts for various electrical equipment in the United States. The Skinner Engine Company, of Erie, Pa., recently secured a contract from the Yokohama office, calling for two fair-sized engines for installation in a Tokio electrical plant. The General Electric Company is building a 300-kw generator for the Kobe Dockyards; the Adams-Bagnall Electric Company, of Cleveland, Ohio, has obtained an order for several hundred globes, etc., which are intended to be shipped to Singapore; and the New York Insulated Wire Company, 15 Cortlandt Street, has a contract for tape, to be forwarded to the same part of the world. The Gibson Gas Fixture Works Company, of Philadelphia, have also got an order on hand for electric fixtures to be shipped to the Straits Settlements.

CONTRACTS PENDING FROM HONG KONG.—Mr. W. G. Winterburn, general manager of G. B. Fenwick & Co., which concern operates a large foundry and general machine shop in Hong Kong, China, has been in the United States for the past two months. He has been inspecting our various shop methods and gathering data with a view to the re-equipment and extension of the Fenwick works, which would include the extensive use of electric transmission machinery, etc. He left New York last week en route for China via San Francisco. Very shortly after his arrival in Hong Kong it is anticipated that some substantial contract will be dispatched to manufacturers on this side.

LARGE BUCKEYE ENGINES FOR TAMPA (FLA.) PLANT.—The Buckeye Engine Company, of Salem, Ohio, and 39-41 Cortlandt Street, New York, has just secured a contract valued at over $100,000 for two 1800-hp cross compound condensing engines, together with three similar type of engines of 300 kw each. This equipment will be installed at Tampa, Fla., where the engines are to drive the general power station in that Southern city. The Buckeye plant is stated to have been working day and night since 1893. This is claimed as the record for continuous operation of any manufacturing plant in the country.

WESTINGHOUSE GAS ENGINES AND ELECTRIC GENERATORS.—Westinghouse, Church, Kerr & Co. have secured a contract calling for the supply of two 175 brake-hp and the same number of 125 brake-hp, three cylinder Westinghouse gas engines, which will be direct connected to two 110-kw and two 75-kw generators to be built by the Westinghouse Electric & Manufacturing Company for installation in the new Keystone Bank Building, Pittsburg, Pa. The equipment, which will be one of the largest plants of its description in the country, will be utilized for electric lighting and power purposes.

PACIFIC COAST ELECTRICAL EXPORTS.—For some time past this Department has recorded the electrical exports from New York port. There has now sprung up, however, a considerable export trade via San Francisco. During the month of October the exports of electrical material from the port of San Francisco reached a valuation of no less than $14,328. We propose recording these exports month by month in addition to our weekly reports for the port of New York.

BIG BUCKEYE-GENERAL ELECTRIC EQUIPMENT.—The New York, New Haven & Hartford Railroad Company's new power station at Berlin, Conn., is to be equipped with two 1400-hp cross-compound condensing Buckeyes the same number of condensers each having a capacity of 25,000 lbs. and independent beam air pumps of 25 by 18 dimensions. The generators of 1000 kw capacity each are to be furnished by the General Electric Company.

THE BALL ENGINE COMPANY, Erie, Pa., has recently furnished a 175-hp engine for electric power to the Modoc Coal & Mining Company, Jacksonville, Ohio. The American Ordnance Company, Bridgeport, Conn., recently purchased a 300-hp tandem compound direct-connected engine from the Ball Company. The Evansville Water, Light & Power Company, Evansville, Wis., is installing a Ball engine.

LIGHTING PLANT FOR HOBOKEN CONCERN.—The Hoboken Land & Improvement Company has just placed orders for one 75-hp and one 60-hp simple horizontal Buckeye engines, for electric lighting, direct connected to 50-kw Westinghouse and 60-kw Lundell generators, respectively.

SUBWAY POWER STATION.—The Rapid Transit Subway Construction Company has purchased a site on East Nineteenth Street, New York, for a sub-power station to cost from $60,000 to $70,000.

THE EUREKA TEMPERED COPPER WORKS.—North East, Pa., has just shipped a large order of gauze brushes to Amsterdam, Holland.

Telephone News and Notes.

SCOTTSBORO, ALA.—W. L. Moody and several others are putting in an independent telephone system.

CORNING, ARK.—The Corning Telephone Company will extend its lines and have long distance connection in the near future. It uses a Western Electric 100-drop board and has 85 subscribers. Growth is normal and prospects bright.

BLACK ROCK, ARK.—Messrs. Anderson and King operate five switchboards of 500-drop capacity and have 100 subscribers. Fifty new instruments are projected and the outlook is very bright. They use apparatus of the American Electric Company.

CONEJOS, COLO.—The Extension Telephone Company uses apparatus of the Colorado Telephone Company, has a 20-drop board and 75 subscribers. Recent growth has been good and prospects are bright.

EAST HAVEN, CONN.—The East Haven Telephone & Electric Company uses apparatus of the Connecticut Telephone & Electric Company. The company has a 3-drop board and 36 subscribers.

TAMPA, FLA.—The Peninsular Telephone Company has increased its capital stock from $200,000 to $500,000.

STARKE, FLA.—The Starke Telephone Exchange is making excellent progress, having added 16 telephones lately, with probable increase to 100. Switchboard capacity is 100 drops with 76 subscribers. Rates, $1.50 per month. All this within three months, and in a small place shows great enterprise. Mr. M. G. Rowe is the manager.

DAYTONA, FLA.—We are indebted to the secretary of the Daytona Telephone Company for the following: It operates a 200-drop board with apparatus of the Kokomo Telephone & Electric Manufacturing Company, and has 100 subscribers. An exchange has recently been established at Sea Breeze, and another line is being built to De Land.

GAINESVILLE, GA.—The Dahlonega Telephone Company uses Bell apparatus; a 24-drop board and 8 subscribers. Extensions and local work are in progress and prospects are bright.

FORT GAINES, GA.—Mr. J. H. Haskins operates his line here with apparatus of various makes. He has a 100-drop board and 85 subscribers. A toll line to Eufaula, Ala., is contemplated.

MONTICELLO, GA.—Mr. Hecht, proprietor of the Monticello Telephone exchange, uses Sumter apparatus, a 100-drop board and 50 subscribers. Advance has been rapid and the future looks bright.

MURRAY, GA.—The Murray County Telephone Company has several miles of line and several stations. Victor and American electric apparatsu is installed. Mr. W. R. Davis expects that future railway improvements will give a stimulus to business.

WINDER, GA.—The North Georgia Telephone & Telegraph Company informs us, through Mr. Irwin, that a toll line to Atlanta is projected. A Southern Bell switchboard of 100 drops is operated, and it has 60 subscribers. Recent growth and future indications are good.

PASCHAL, GA.—The Union Telephone & Electric Light Company has a 110-drop board at Talbotton and one of 100 drops at Buena Vista. It uses American Electric & Western Telephone apparatus and has 275 subscribers, with an expected increase. We are indebted to Mr. Moore, secretary and treasurer, for the above information.

STREATOR, ILL.—The Streator Independent Telephone Company has increased its capital stock from $40,000 to $100,000.

BARRY, ILL.—The Adams-Pike counties and Hannibal Telephone Company will be incorporated, and will then try to build its line into Hannibal.

CORDOVA, ILL.—The Cordova Creamery Telephone Company is of recent formation. It operates a 10-drop board of American make and has 52 subscribers.

BRIMFIELD, ILL.—The Brimfield Telephone Company finds business pretty fair and the outlook good. It operates a 100-drop board and has a subscription list of 51.

DELAVAN, ILL.—The Boynton Mutual Telephone Company has installed apparatus of the Chicago Telephone & Supply Company. There are 20 subscribers and rates are $1 per month.

STANFORD, ILL.—The Stanford Telephone Company operates 275 telephones from a 100-drop American board. Its business is mostly rural, and there are probably 100 prospects in its territory.

MASCOUTAH, ILL.—The Kinloch Telephone Company is at work extending its line to O'Fallon from Belleville. After the completion of the O'Fallon line work will be commenced on the line to Mascoutah.

MARTINSVILLE, ILL.—The Martinsville Telephone Company operates a 200-drop board of the Western Telephone Construction Company make, and has 150 subscribers. The outlook is extremely promising.

FRANKFORT STATION, ILL.—The Northwestern Telephone Company has built a line from Mokena to Tinley Park and will build a toll line to Peotone. Also, a line will be built immediately east of Frankfort.

RIDGWAY, ILL.—The Gallatin County Telephone Company operates a 100-drop board of American make and has 168 subscribers. Toll service is $1 and $1.50 for residences and business places respectively.

HOPEDALE, ILL.—The Mutual Telephone Company has a 100-drop board with 175 subscribers. A large increase is projected; service and lines are first class. American and Stromberg-Carlson apparatus is used.

KIMMUNDY, ILL.—The Salem Telephone Company operates Chicago apparatus with a 200-drop board and 165 subscribers. Mr. Sims informs us that growth is steadily improving and that rural lines are projected.

HAMILTON, ILL.—The Farmers' Mutual Telephone Company operates a Central Union 100-drop board, and has about 50 subscribers. It puts up its own lines and rents telephones from the Central Union for $8 per year.

CARLOCK, ILL.—The Farmers' Telephone Company is in the hands of neighboring farmers, who build their own lines, one connecting with the other, and forming lines around Carlock, Hudson, Genoa and many other towns.

CARLINVILLE, ILL.—The Carlinville Telephone Company has extended its lines from Shipman to Plainview. The work of extending the lines to Carlinville is in progress, and will soon be completed, making a complete circuit of the country.

CERRO GORDO, ILL.—The Cerro Gordo Telephone Company, although in business only since last May, has prospered exceedingly, and expects a large increase the coming year. It uses Sterling apparatus, and has a 200-drop board with 160 subscribers.

BELLEVILLE, ILL.—The telegraph, telephone and electric light wires on the public square are to be put underground as soon as the City Council passes an ordinance directing it to be done, as the companies interested have given their assent to the proposed improvement.

MONMOUTH, ILL.—The Monmouth Telephone Company commenced operations July with 300 telephones; growth in four months, 205, with every prospect of an equal increase in the next four. A Sterling 500-drop board supplies 505 subscribers. Prospects could not be brighter.

SALEM, ILL.—The Salem Telephone Company has several exchanges and the increase in one of them, Sandoval, has been rapid. A toll line is also operated. With an 800 drop board, it has 758 subscribers, which number promises an early increase. Mr. Hull is the proprietor.

CHISTEN, ILL.—Mr. A. W. Gordon, of the Gordon Telephone Company, informs us of continued healthy growth in telephone business. He operates Stromberg-Carlson apparatus, with a 200-drop board, and has 220 subscribers. The principal work at present is connecting up farmers.

GREENVILLE, ILL.—The City Council has granted a franchise for a new telephone company to erect poles and wires and maintain an office in Greenville. The new line is to be operated in connection with the Kinloch system and the city is to receive 1 per cent of the gross earnings.

WARRENSBURG, ILL.—We are in receipt of the following from Mr. C. C. H. Cowen, manager of the Warrensburg Telephone Company. It is using Western Electric apparatus, it has a 50-drop board and 150 subscribers, including farmers on party lines. A large increase is projected.

MANHATTAN, ILL.—We are informed by Mr. Tennysen, of the Manhattan Telephone Company, that apparatus of various makers is used by his company. The switchboard capacity is 100 drops, having 10 bridging lines. The number of subscribers is 100. Good prospects of an increase.

STAUNTON, ILL.—The manager of the Staunton Telephone Company, Mr. Williamson, informs us that its Western Construction Company's apparatus has switchboard capacity of 200 drops. It has 140 subscribers and a large number in prospect. The company only commenced operations Jan. 1, 1891.

ROCHELLE, ILL.—The Ogle County Telephone Company informs us through Mr. A. A. Phelps that prospects were never better. With American Electrics and Stromberg-Carlson apparatus, it operates a 1000-drop board and has 800 subscribers. It also has stations at Oregon, Polo, Mt. Morris and other places.

CHICAGO, ILL.—The Chicago Telephone Company has recently been troubled by the cutting of wires in outlying parts of the city. The cutting is taking place striking linemen or their sympathizers. The work has interfered seriously with on the North, West and South Sides, and is generally believed to be the work of some of the suburban exchanges.

GALVA, ILL.—We are indebted to Mr. Wyberg, manager of the Galva Telephone Company, for details of his very successful enterprise. He operates Stromberg-Carlson apparatus. The switchboard has two sections of 100 drops each, and they accommodate 250 subscribers, while 60 more are to come in. Prospects and service satisfy all parties.

HARDIN, ILL.—The Calhoun County Telephone Company has decided to extend its lines into St. Louis. At a meeting of the directors of the company. The decision was reached to run the line by way of Grafton, and thence along the Illinois shore of the Mississippi River into St. Louis. This will give St. Louis three independent telephone lines to nearby points in Illinois.

MINIER, ILL.—The Mutual Telephone Company, of Minier, operates a 300-drop board, of which 225 are installed. The apparatus is of American and Stromberg-Carlson make. It has 430 subscribers, 245 of them on farms, and its territory covers six townships. The company consists of 12 business men who believe in low rates and small profits in view of other benefits arising from such arrangements.

CHICAGO, ILL.—President Sabin, of the Central Union Telephone Company, has sent to stockholders a report of the business done by months so far this year. The rental earnings in January were $126,411, and in October $153,770. It is estimated in the circular that the rental earnings for November will be $156,000 and in December $160,000. At the time of Mr. Sabin's connection with the company in April there were 75,341 stations. At the end of October there were 91,485, a gain of 16,144.

TELEPHONE NEWS.—(Continued.)

ANGOLA, IND.—The Farmers' Telephone Company, of Steuben County, has been incorporated with $1,500 capital stock.

UNION CITY, IND.—The Union City Telephone Company has increased its capital stock from $30,000 to $50,000. The lines will be extended into the rural districts.

BOWERS, IND.—The Co-operative Telephone Company, using Eureka instruments, has a 50-drop board and 76 subscribers. Service is good and very satisfactory.

MILAN, IND.—We learn from Dr. D. C. Roney that he operates a 6-drop switchboard. Six miles of new line are to be built and prospects of improvement are good.

HALL, IND.—Mr. R. W. Brown is the proprietor of this telephone line, which operates American Electric and Chicago apparatus, and with switchboard capacity of 25 drops and 40 subscribers.

HAZELRIGG, IND.—The Hazelrigg Co-operative Telephone Company is operated on the co-operative system, and has a 100-drop board of Eureka Electric Company make, with 80 subscribers.

MOORESVILLE, IND.—This city enjoys the distinction of having three telephone systems, the last being a local affair recently installed, and connects the town with the farmers for miles around.

WARREN, IND.—The Warren Telephone Company, owned by J. M. Hollingsworth, operates a 200-drop board of American make and has 165 subscribers. Some extensions are projected and the outlook is fair.

INDIANAPOLIS, IND.—The Chrisney & Grandview Home Telephone Company, Spencer County, has been chartered; capital stock, $5,000. Directors: L. F. Gage, G. J. Clement, D. S. Goble, J. P. Chrisney and T. E. Chrisney.

CROTHERSVILLE, IND.—The Jackson Telephone Company operates a 100-drop board of American make and has 65 subscribers. Nearly as many more are expected. Mr. Warner informs us that the outlook is good.

SHELBYVILLE, IND.—The Cove Telephone Company informs us through Mr. Williams, that a 100-drop Eureka board is operated, with 88 subscribers. He expects that in the near future telephones will be found in every house.

ALBANY, IND.—The Albany Telephone Company, using Globe automatic apparatus, has a 100-drop board and 59 subscribers. Mr. Perkins informs us that business is good and that an exchange and country lines will soon be built.

CORUNNA, IND.—Mr. M. J. Thomas, of the Thomas Telephone Exchange, kindly furnishes us with the following: With a 25-drop board it has 90 subscribers, and business is steadily increasing. Subscriptions or toll service is $12 per year.

CENTER POINT, IND.—The Center Point Telephone Company has a 10-drop switchboard and 60 subscribers. An increase of nearly as many more is expected. We are indebted to Mr. W. S. Gard, secretary of the company, for this information.

TAYLORSVILLE, IND.—The Taylorsville Telephone Company reports business in good shape. The apparatus used is American Electric; a 100-drop board and 30 subscribers. Seven county lines have recently been built and more are in contemplation.

ANGOLA, IND.—A new switchboard with a capacity for 300 subscribers has been ordered and will be installed in the exchange of the Steuben County Electric Telephone Company. The demand for service has grown to most encouraging proportions.

HUNTINGBURY, IND.—The Dubois County Telephone Company has a successful and constantly improving undertaking. Eureka apparatus supplies a 200-drop board, with 190 subscribers. In addition there are 169 in Jasper, Dubois and other towns.

PERRYSVILLE, IND.—Mr. C. Carpenter, of the Perrysville Telephone Company, informs us that extensions and more telephones are planned for the near future. Apparatus of the Eureka Electric Company is installed; a 50-drop board and 65 subscribers.

ELWOOD, IND.—After repeated attempts during the past two years, the Long Distance Telephone Company, of Indianapolis, has at last succeeded in getting a franchise to establish a new system at Elwood. The plant is to be in operation within four months.

VINCENNES, IND.—The City Council has granted a franchise to the Independent Telephone Company for twenty-five years. The Central Union Company is just finishing a $25,000 improvement, and a telephone cut rate war is expected when the second plant is established.

DANA, IND.—The Citizens' Mutual Telephone Company, which has just started business, commences under favorable auspices, with a switchboard at Dana and Newport, of 100 drops, 50 subscribers at Newport and 75 at Dana. American apparatus is used, and an extension is contemplated.

BREMEN, IND.—The Bremen Telephone Company is the property of Koontz Bros., and we are indebted to the manager, Mr. C. E. Koontz, for the following: He operates apparatus of the Eureka Electric Company, with a 100-drop board and 80 subscribers. Prospects for an increase are favorable.

ANGOLA, IND.—Norman C. Shank, president; George Rude, vice-president; Chas. W. DeLancey, secretary and treasurer, incorporated as the Farmers' Telephone Company of Steuben County, will ask the village Council for a permit to establish an exchange here. The company has a line from Orland to Nevada Mills.

SOUTH McALESTER, IND.—The South McAlester-Eufaula Telephone Company operates Central, Eureka and Standard apparatus; has five exchanges, 400 drop boards and 400 subscribers. Mr. L. H. Roberts, general manager, informs us that 600 miles of toll lines have been put in recently and prospects are excellent.

CANTON, IND.—The Hoosier Telephone Company has Eureka and American installations; an 800-drop board and 1200 subscribers. There are 8 exchanges all connected by a first class metallic circuit, and 200 miles of toll line, with projected extensions. We are indebted to Mr. J. M. Morris for the above information.

QUINCY, IND.—The Mugg Telephone Company informs us through Mr. Carlton, its secretary, that it has first-class toll service to every town in the county. It uses Eureka apparatus, a 200-drop board and has 125 subscribers. It has connections over copper lines of the New Long Distance Company. It has an exchange at Spencer.

EUREKA, IND.—The Ohio Township Telephone Company has increased its capital stock from $1,150 to $10,000, and now proposes to place a 300-drop switchboard in Rockport and connect all the independent plants. Elliott Telephone Company and North Electric Company apparatus is used. There are now 44 subscribers. Mr. F. H. Crowder is secretary.

GOSHEN, IND.—The manager of the House Telephone Company sends us the following items: It is operating apparatus of various companies; has an 800-drop board in Elkhart, and 500 in Goshen, with 720 subscribers in the former place, 480 in the latter. There has been a great gain recently, and it has many orders ahead. Additional cable room for 500 is projected.

INDIANAPOLIS, IND.—The instruments used by the New Telephone Company are from the Kellogg Switchboard & Supply Company. The switchboard capacity is 6000 drops; number of subscribers, 4527. The company has just contracted for two sub-stations of 1800 and 2500 respectively, and is connected with the New Long Distance Telephone Company, one of the finest properties in the West.

GREENSBURG, IND.—The Bell Telephone Company has a force of 50 men at work building its long-distance lines in this and adjacent counties. The company has just completed its lines from Madison and North Vernon to this city and is extending them to Hope and other points in Bartholomew County. Every point in Decatur County is now reached by either the Bell Company or the Decatur County Independent Telephone Company.

NORTH VERNON, IND.—The North Vernon & Vernon Telephone Company informs us that it operates a Stromberg-Carlson switchboard of 325 capacity, and has 310 subscribers. The outlook is the very best. Mr. Kendrick, the manager, also informs us it owns and operates the Gunnings County Telephone Company, which has 125 miles of toll line, reaching 18 small towns, and it expects to build large extensions in Spring. This latter company has 75 subscribers.

ROCKVILLE, IND.—The Parker County Telephone Company has sub-exchanges at Bellmore, Bridgeton, Rosedale, Montezuma, Mecca and West Union. The main office has 400 lines, the sub-stations 100 each. They employ principally Eureka, Sterling and Victor apparatus. Subscribers number between 500 and 600. Mr. Haynes, manager, informs us that the plant has doubled in the last year. The company has 125 miles of toll line and includes 30 towns in its system.

MUNCIE, IND.—The telephone war at this place has assumed a new phase. The independent company, which has been seeking admission, was promised a franchise as soon as it secured 800 subscribers. The company renewed its petition and filed a list of 850 subscribers secured. A member of the Council charged fraud, alleging that many of the names had been secured by misrepresentation. This charge was resented and the feeling is intense. The franchise is being withheld pending an investigation. At the time the promise was made it was thought the restriction would bar the company from the city.

DUNKIRK, IND.—The city attorney has been instructed to prepare an ordinance to tax the Central Union's poles to the utmost limit, also one revoking the franchise of the company, on the ground of grave abuses of rights and privileges. The telephone fight has been of interest here for some time. The city appropriated $2,500 to put in a municipal plant, but did not have the $2,500, and the project failed. The Central Union began its improvements and disturbed the sewer and the workmen were arrested. A citizens' company was organized and an old franchise purchased and the fight is on now for supremacy. There are but few complaints against the Central Union's service, but the people want competition, and a hostile feeling has developed. The attempt to revoke the franchise will be vigorously contested.

MIAMI, IND. TERR.—The Miami exchange has a 100-drop board and 56 subscribers, with a large expected increase. Mr. Crandall is the manager. The exchange uses Western apparatus.

PURCELL, IND. TERR.—The Purcell & Lexington Telephone Company uses American apparatus; at the former place a 22-drop board, the latter 100. There are 214 subscribers. Purcell exchange has been rebuilt and new transmitters put in. A new toll line to Chickasha is projected.

MURRAY, IDAHO.—Mr. A. Aulbach is proprietor of the telephone line between Murray and Wallace, with branch lines 3 to 7 miles to mines in the mountains several miles distant from the main wire. There are great opportunities in this direction. Mr. Aulbach thinks his the only independent line in Idaho.

CLARINDA, IA.—A company has been organized to build a telephone line between Page Center and College Springs.

CROYDON, IA.—The Wayne County Telephone Exchange uses a 200-drop American switchboard and has 150 subscribers.

MUSCATINE, IA.—The Wilton Telephone Company, capital stock $3,000, has been incorporated. J. M. Rider is president.

NEWELL, IA.—The Northern Telephone Company uses Eureka apparatus and has a 100-drop board, 40 installed, and 40 subscribers.

MARCUS, IA.—A 15-year franchise has been granted to the Marcus Telephone Company. Mr. F. S. Barnes is interested in the company.

TELEPHONE NEWS.—(Continued.)

SANBORN, IA.—The Sanborn Telephone Company operates a Chicago 130-drop board and has 100 subscribers. Growth and outlook both excellent.

AUDUBON, IA.—The Audubon County Telephone Company operates an American 250-drop board and has 250 subscribers, which indicates a flourishing business.

BUSSEY, IA.—The Bussey Mutual Telephone Company uses Chicago apparatus. It has 50 telephones, and the outlook for the next six months promises as many more.

SHELL ROCK, IA.—E. H. Eckles, of Tama County, has purchased the telephone line of the Cedar Valley Company running to this place and will enlarge the system.

NEW LONDON, IA.—We learn from Mr. Stephenson, of the Henry County Telephone Company, that a drop board of 150 capacity is operated, with 200 subscribers. The outlook is good.

HARTLEY, IA.—Mr. F. E. Fee, owner of the telephone line, operates a Standard 80-drop board and has 78 subscribers. Increase is steady and the outlook promises well for the future.

SEHALLEN, IA.—Mr. Whiteside, of the Sehallen Telephone Company is installing new lines and reports a steady increase. A 100-drop board is operated and there are 60 subscribers.

IOWA CITY, IA.—The Farmers' Mutual Telephone Company, of Johnson County, has filed articles of incorporation, with a capital stock of $4,500. Noah Yoder and others are the incorporators.

WAPELLO, IA.—The Mississippi Valley Telephone Company operates a 200-drop American switchboard and has the same number of subscribers. Progress has been very rapid, with every prospect of continuance.

MARATHON, IA.—Mr. A. P. Welch, of the Marathon Telephone Exchange, informs us of a contemplated increase on farmers' lines. It uses Stromberg-Carlson apparatus and has a 100-drop board, with 50 subscribers.

BOONE, IA.—Mr. Deering, of the Boone County Telephone Company, informs us of good prospects and fair business. Western apparatus is used, and a 600-drop board with 595 subscribers constitute a thriving business.

BATTLE CREEK, IA.—The Battle Creek Telephone Company has made good progress since its start early this year. It has a Eureka board of 100 drops and 125 subscribers. Rates are $1.75 for subscription or toll service.

LEON, IA.—The Leon Telephone Company operates Keystone apparatus; a 100-drop board with 162 subscribers. There are about 20 miles of farm lines and more projected. Mr. Ellinwood, the manager, reports a fair outlook.

BLOOMFIELD, IA.—The Davis County Telephone Company uses an American drop board of 200 capacity, 160 lines being installed. There are about 200 subscribers. Recent growth has been good and new toll lines are projected.

DAYTON, IA.—The Dayton Telephone Company has just completed its organization here, J. A. Lindberg being chosen president and Dr. M. F. Anderson vice-president; Dr. H. E. Nelson, secretary, and E. M. Lundien, treasurer.

CORNING, IA.—The Corning Telephone Company uses Victor apparatus, and is about to install some of Stromberg-Carlson make. The present 180-drop board supplies 190 subscribers. One or two exchanges and new toll lines are contemplated.

JESUP, IA.—The Buchanan County Telephone Company operates an American 50-drop board and has 43 subscribers. Mr. Cates informs us that the exchange started business in June of this year and that new farmers and town lines are already projected.

MAPLETON, IA.—The Iowa Telephone Company uses Bell apparatus, has a 15-drop board and 15 subscribers. The New State Company has Swedish-American apparatus and its toll lines cover a large territory. The Bell uses metallic circuits and the State grounded.

GUTHRIE CENTRE, IA.—The Guthrie Center Telephone Company uses Swedish-American apparatus, and operates a board at North Branch, with one of 50 drops at Bayard. There are about 60 subscribers and the company has some 30 miles of party lines. Mr. A. D. Carothers is president.

OAKLAND, IA.—The Harlan-Avoca Telephone & Telegraph Company informs us through Mr. M. Babcock, secretary, that a switchboard of 600 drops supplies the needs of 475 subscribers at present. An increase of 200 is projected. Subscription rates are $24 and $12 per annum.

LAKE CITY, IA.—The North Coon Telephone Company operates a 200-drop board at Lake City and lever switchboard at Glidden, of Stromberg-Carlson make. It has 36 subscribers at present, and another wire will be built next spring. Almost every rural home will probably have telephone connection soon.

FONDA, IA.—The Northern Telephone Company sends us the following through Mr. Coleman, its secretary. The apparatus used is Eureka. There are 3 new exchanges at Aurelia, Newell and Gilmore City, and farm lines are projected. A 200-drop board is operated and there are 125 subscribers in Fonda.

OSBORNE, KAN.—The Osborne Telephone Company employs apparatus of the National Automatic Company. It has 100 telephones and 98 subscribers.

GARDEN CITY, KAN.—The Garden City Telephone Company employs National Automatic apparatus and has 55 subscribers. Rates are $1 and $2 respectively for residences and business houses.

LYONS, KAN.—Mr. A. Long, of the Lyons telephone exchange, informs us that it has a steady increase of business and project farmers' lines. Its drop-board capacity is 200, with 182 subscribers, and its rates are $1 for residences, $2 for business houses.

STOCKTON, KAN.—We are informed by Mr. L. D. Burchfield that he operates Stromberg-Carlson apparatus of 120-drop switchboard capacity, and has 105 subscribers. Rates for residence and business houses are $1 and $2 respectively and prospects are good.

ST. MARYS, KAN.—The St. Marys Telephone Company operates an automatic and toll line of 80 switches, with apparatus of the National Automatic Telephone Company. There are 80 subscribers. Mr. Anderson, secretary, reports a favorable outlook and a projected 10-mile toll line.

CALHOUN, KY.—At present there is no independent company operating an exchange here, but Mr. A. L. Mosely informs us that there is a good opening for one.

NEW HAVEN, KY.—We are indebted to the secretary of the New Haven Telephone Company for the following particulars: The company has made its own apparatus, and operates a 20-drop board, with 20 subscribers.

DONALDSONVILLE, LA.—Mr. L. H. Lancaster, a representative of the American Telephone Company, was in town looking over the field preparatory to the establishment of an exchange here.

ALEXANDRIA, LA.—The Cumberland Telephone & Telegraph Company, which bought out the Alexandria Telephone Company, January, 1901, is installing an entirely new system. The apparatus is made by the Cumberland Telephone & Telegraph Company; switchboard capacity, 400 drops, number of subscribers 300. Recent increase has been large and prospects are bright.

SEBAGO, ME.—The Baldwin & Sebago Telephone Company is a small concern using Bell apparatus.

HARTLAND, ME.—There is no telephone company in this place, only a local line and one to St. Albans, owned by Dr. C. A. Moulton.

CORINNA, ME.—The Corinna Telephone & Telegraph Company has exchanges at Stetson and Exeter also. It has a 6-drop board and 20 subscribers.

UNION, ME.—The Union Telephone Company operates a 25-drop board of the American Electric Company make, and has 50 subscribers. Extensions of five and ten miles are contemplated. The outlook is very favorable.

PORTLAND, ME.—The Dirigo Telephone Company, of Maine, whose lines cover the western section of the State, has nine exchanges and 25 pay stations. It has nearly 1000 subscribers, the number increasing rapidly, and it contemplates extensions throughout the entire State. Apparatus, Stromberg-Carlson, Ericcson, Couch-Seeley and Kellogg.

HOYES, MD.—The Garrett County Telephone Company has a Keystone Electric 50-drop board, with 40 subscribers. A 10 to 15 mile extension is projected.

WOLFSVILLE, MD.—We are indebted to Dr. A. J. Smith, president of the Catoctin Telephone & Telegraph Company, for details of his enterprise. His line was only built to obtain connection with the county town, but will probably be extended in the near future.

FITCHBURG, MASS.—The North Fitchburg and Bunker Hill lines cover all territory adjacent to the places named, and have 20 subscribers, each telephone representing a share in the company. Mr. C. A. Chuton is secretary.

FALL RIVER, MASS.—The Fall River Automatic Telephone Company operates Strowger apparatus of from 1000 to 2700 as required, and has 600 subscribers, 70 being added during the past month. Prospects are very good for a large increase. Mr. V. A. Sears has kindly furnished the above.

ADRIAN, MICH.—The Midland Telephone Company and local telephone exchange have 100 subscribers, and a bright outlook. They employ Stromberg-Carlson apparatus.

FREMONT, MICH.—The manager of the Citizens' Telephone Company informs us that it has a 100-drop board and 88 subscribers. The outlook promises well for the future.

BEAVERTON, MICH.—Dr. F. S. Pierce operates apparatus of the Michigan Telephone Company and has had a considerable increase with projected improvement in the future.

BELLEVUE, MICH.—The Citizens' Telephone Company, with headquarters in Grand Rapids, has installed apparatus of Geo. G. Smith. It has a 100-drop board and 66 subscribers.

DETROIT, MICH.—The American Telephone Directory Company has been incorporated with a capital stock of $5,000, by John D. Browning, Charles E. Smith and Clark S. Potter.

SPARTA, MICH.—The Sparta Telephone Company informs us that it goes on steadily improving. The switchboard of American make has a capacity of 100 drops and there are 30 subscribers.

CHARLOTTE, MICH.—The Eaton County Telephone Company uses American and Williams apparatus. A 350-drop board supplies 344 subscribers and 100 rural connections are about to be made. Growth has been rapid.

BERRIEN SPRINGS, MICH.—The Twin City Telephone Company employs Stromberg-Carlson (central energy) apparatus, and has a 50-drop board with 35 subscribers. It has stations at Benton Harbor and St. Joseph, Mich.

LESLIE, MICH.—The Leslie Telephone Company operates a 150-drop board, and including farmers' lines, business and private telephones, has a subscription list of 250. Building extensions are in progress and prospects are good.

WILLIAMSBURG, MICH.—The Williamsburg Telephone Company is a small local enterprise connecting with other larger lines. It has a 5-drop board and 25 subscribers. M. B. Wheeler Electric Company's apparatus is installed.

FITCHBURG, MICH.—The Fitchburg Telephone Company uses apparatus of local make and has 12 party lines, using call bells in the towns which they connect. Mr. E. W. Lawrence, president, gives a good account of the business outlook.

GAYLORD, MICH.—The Otsego County Telephone Company has proved such a success that its projectors contemplate a second exchange at Vanderbilt, Mich. They operate a Stromberg-Carlson, 100-drop board and have 95 subscribers. Mr. F. Calkins tells us that growth has been rapid.

SCHOOLCRAFT, MICH.—We are indebted to Mr. Burney, proprietor of the Schoolcraft Telephone Company, for the following: He uses Stromberg Telephone Manufacturing Company's apparatus, has a 100-drop board and 45 subscribers. Several country lines, with from 50 to 100 more, are projected. The sale of the Central Telephone Company has bettered conditions and the outlook is very bright.

TELEPHONE NEWS.—(Continued.)

VERNDALE, MINN.—The Verndale Telephone Company operates apparatus of the National Automatic Telephone Company, and has 100 switches, 52 installed, with 52 subscribers.

GLENCOE, MINN.—The Glencoe Telephone Exchange Company uses Standard apparatus and operates a 200-drop board, with 150 subscribers. About 50 miles of farmers' lines are to be built.

RED WING, MINN.—The Northwestern Telephone Exchange operates a 300-drop board of Western Electric make, and has 250 subscribers. Mr. Hastings informs us that prospects are very good.

CANTON, MINN.—Mr. Dunford informs us that he uses a switchboard of his own make, and that he operates 15 toll lines, with the Standard and Winona Telephone companies' lines also, giving 130 subscribers.

BIRD ISLAND, MINN.—The Kandiyohi County Telephone Company is building a line from this place to Lake Lillian, where it will connect with a line to Willmar, Atwater and other places in Kandiyohi County.

LONG PRAIRIE, MINN.—The Minnesota Electric Telephone Company informs us through Mr. Dick that Eureka apparatus is used. A 100-drop board and 89 subscribers. The system is being rebuilt, and the outlook is favorable.

MONTEVIDEO, MINN.—The Citizens' telephone exchange has had a good year and contemplates farmers' lines for the next. Western apparatus is employed, and with a 200-drop board it has 165 subscribers. Mr. Zienbeck is secretary.

HECTOR, MINN.—The Hector Telephone Exchange Company, using Standard and Stromberg-Carlson apparatus, has a 100-drop board and 65 subscribers. The company contemplates building two or three farmers' lines of about 15 miles each.

HOUSTON, MINN.—We are informed by Mr. Schoulan, of the Houston Telephone Company that it projects a big increase in farm lines. It uses Standard Madison apparatus and has service and growth of the best. There are 30 subscribers.

GRAND MEADOW, MINN.—The Home Telephone Exchange Company informs us that its apparatus is of L. M. Ericsson make. It operates a 100-drop board and has 169 subscribers. An increase of 50 telephones is projected, and the outlook is excellent.

BENSON, MINN.—We are indebted to Mr. L. W. Stone for information respecting his telephone lines. He employs Victor apparatus, has a 100-drop board and 123 subscribers, and has had a steady increase since opening business. Independent apparatus is used throughout.

WADENA, MINN.—We learn from Mr. Toole that the Iron Range Electric Telephone Company has absorbed the Norman County Telephone Company and is putting in metallic circuits throughout, and building a new exchange in Ada. A Kellogg 100-drop switchboard is installed, and the company starts with 65 subscribers.

GLASGOW, MO.—The Glasgow Telephone Company operates a 164-drop board and has 215 subscribers, with a continually steady increase.

RAVENNA, MO.—The Ravenna Telephone Company operates a 20-drop board, with 95 subscribers. Its apparatus is Keystone-American and Victor. Prospects are good.

CHILLICOTHE, MO.—Messrs. Leach & McArthur informs us that they use Western apparatus, have a 500-drop board and 450 subscribers. Growth has been very large recently.

KANSAS CITY, MO.—The Kansas City Home Telephone Company, with a capital stock of $50,000, has been incorporated by O. C. Snider, John Enoch, Ed. L. Barker and others.

RICHLAND, MO.—The D. I. Kusel Telephone & Electric Manufacturing Company, of St. Louis, has secured a telephone franchise in this place, and has secured 70 subscribers to its service.

CAMERON, MO.—Mr. Thompson, of the Cameron Telephone Company, reports steady and increasing business. The company has Western apparatus, a 400-drop board and 308 subscribers.

HARRIS, MO.—The Harris-Princeton Telephone Company has a 20-drop board at Princeton and 10 at Harris. There are 20 subscribers, and the prospects for success are very promising.

EVERTON, MO.—The apparatus operated by the Everton Telephone Company is made by Wm. Jones, of this place. The switchboard capacity is 10 drops, and there are 50 subscribers.

BOSWORTH, MO.—The Bosworth Telephone Company has been incorporated, with a capital stock of $4,000. The incorporators are W. J. Williams, W. S. Windsor, G. L. Reavis and others.

WARRENTON, MO.—The Warrenton Telephone Company operates 19 instruments on a line 20 miles in length. It uses the bridging system and has 4 lines running into one office with plug switchboard.

CHULA, MO.—The Laredo Telephone Company operates an American 50-drop board and has 30 subscribers. Several new lines are projected and more patrons looked for, as the outlook is very promising.

BOSWORTH, MO.—The Carroll County Telephone Company, of Bosworth, has been incorporated, with a capital stock of $1,000. The incorporators are H. A. Forsythe, R. E. Cabbell, W. P. Stout and others.

MOVINGER, MO.—We have received the following from Mr. Hemrick, of the Movinger Telephone Company. It operates a 25-drop American board, with 16 subscribers, and has good prospects for the future.

BROOKLYN, MO.—The Harrison County Mutual Telephone Company, of Brooklyn, has been incorporated with a capital stock of $9,000. The incorporators are E. Reynolds, F. Davis, J. L. Stanton and others.

GREENFIELD, MO.—The Interurban Telephone Company is operated by Chicago Telephone Supply Company and has a 100-drop board, with 68 subscribers. Mr. A. D. States informs us that the growth is steady and satisfactory.

AUXVASSE, MO.—The Auxvasse Telephone Company, which has been in operation less than a year, has 100-drop switchboard capacity and 40 subscribers. An increase of 25 is projected. National Automatic apparatus is used. Mr. McCue is manager.

HUNTSVILLE, MO.—We learn from Mr. Johnson, manager of the Huntsville Telephone Company, that the outlook never has been better. He operates a 200-drop board of American make, and there are 160 subscribers. In addition there are numerous farmers' telephones, which would bring up the number to about 400.

JAMESPORT, MO.—We are indebted to Mr. A. W. Cropper, manager of the Jamesport telephone exchange, for the following: His apparatus is of American Electric and Stromberg-Carlson make. With a 100-drop board, there are an equal number of subscribers, 16 or 17 party lines, with 4 to 18 telephones on each line, and 3 through lines to the county seat.

ST. LOUIS, MO.—A bill has been introduced in the Board of Public Improvements, providing that all telegraph and telephone wires be placed underground in the underground district. Telephone companies accepting conduit privileges under the proposed ordinance will be prohibited until 1940 from raising their rates for services above those existing Jan. 1, 1900.

MACON, MO.—The Missouri & Kansas Telephone Company has established a long distance exchange at Macon and put in a fine switchboard there. With the completion of the new line to Kirksville, Macon will be the central office for twenty distinct long distance telephone lines, all of which have been built during the past three years. The wires for the Kirksville line have been strung and the instruments are now being placed in position.

CAMPBELLSVILLE, MISS.—The Sunflower & Silver Creek Telephone Company has 11 stations on the line to Yazoo City. American Electric apparatus is used and gives good service.

CRAIG, NEB.—The Craig Telephone Company, capital stock $5,040.75, has been incorporated by George F. Smith, A. Whitney and T. I. Minier.

ARLINGTON, NEB.—Mr. Vail, of the Arlington Telephone Company, informs us that its apparatus is of Farr make. At present a 30-drop board is operated, but it will be increased. There are 41 subscribers, and farmers' lines are projected.

NEBRASKA CITY, NEB.—The Nebraska City Telephone Company operates American, Swedish-American and Eureka apparatus. There is a 400-drop board at this place, one of 100 at Talmage, Julia and Douglas, and one of 25 at Unadilla. There are 700 subscribers, and 240 instruments have been put in since January, 1901. Mr. Munn informs us that business is increasing more rapidly than it can be taken care of.

CHARLOTTE, N. C.—Long distance telephone lines are being constructed from New Decatur, Ala., to Moulton and other points West.

HAMLET, N. C.—The Hamlet Telephone Company has Sumter apparatus and a 100-drop board, with 60 subscribers. It contemplates adding 10 or 15 more telephones, and reports a bright outlook.

ELIZABETH CITY, N. C.—The Camden Telephone Company uses apparatus of American Electric make. It has recently established long-distance connection with Norfolk, Va., and prospects are good for extended business.

STANLEY, N. C.—The Gaston Telephone Company operates long-distance lines connecting towns for about 300 miles, and is extending them. It uses Phœnix switchboards and telephones; also Simplex telephones. It has 50 subscribers.

ELKIN, N. C.—The Wilkin Electric Company, Elkin and Jonesville exchange, uses Sumter apparatus; a 100-drop board, with 65 subscribers, and 4 toll lines. The outlook is very encouraging and a large increase is expected. Mr. H. W. Horton is manager of North Wilkesboro and Wilkesboro exchanges. Both systems are prosperous.

MAXTON, N. C.—We are indebted to Mr. Burns, of the Carolina Telephone & Telegraph Company, for notes of his progressive business. Commencing in 1899 with 25 farms, he now has 70 in operation, and contemplates putting in larger boards to meet the increasing demand. Increase has been rapid and prospects are excellent.

ELKIN, N. C.—Mr. H. W. Horton, of the Wiekin Electric Company, informs us that it has 100-drop boards in North Wilkesboro and Elkin, the apparatus being of the Sumter Telephone Company. Recent growth has been very satisfactory; the town is growing and farmers are becoming subscribers. These latter now number 150.

ST. THOMAS, N. D.—The St. Thomas local telephone exchange uses National Automatic apparatus. It was established in 1900 and has 22 subscribers, with good prospects.

COOPERSTOWN, N. D.—Mr. Goff, owner and manager of the Cooperstown Telephone Exchange, sends word of rapid improvement. His apparatus is American, and a 100-drop Kellogg switchboard takes care of 105 subscribers. Toll lines will be built next summer.

SOMERSWORTH, N. H.—The New England Telephone & Telegraph Company is making arrangements to extend the service in this city the coming winter.

PLYMOUTH, N. H.—The Plymouth & Campton Telephone Exchange Company supplies the towns of Plymouth, Campton, Thornton, Woodstock, Lincoln, Franconia, and several others, operating 5 Western Electric switchboards of 136 drops. There are about 300 subscribers, and Mr. Lee, the manager, informs us that business is increasing fast, both toll and instruments.

BORDENTOWN, N. J.—The general manager of the Bordentown Telephone & Telegraph Company, Mr. Wiese, kindly favors us with the following: He operates a 200-drop board with American Electric apparatus, and has 150 subscribers. Business is increasing steadily and the outlook is excellent.

ROSWELL, N. MEX.—The Roswell Telephone & Manufacturing Company operates an American 200-drop board, and has 180 subscribers. Toll lines

TELEPHONE NEWS.—(Continued.)

and a larger switchboard are projected, for the possibilities seem unlimited in this territory. We are indebted for particulars to Mr. S. D. Saunders, the superintendent.

HOBART, N. Y.—The Hobart Telephone Company operates a 15-drop switchboard and has 50 or more subscribers.

BINGHAMTON, N. Y.—The local telephone company will soon be connected with the Citizens' Telephone Company, of Elmira.

WOODSTOCK, N. Y.—The Woodstock Telephone Company operates a line built by farmers and others, and has no exchange. Mr. Byde Snyder is the manager.

FRANKFORT, N. Y.—The Schuyler Telephone Company reports slow but steady increase. It has a 75-drop board and 72 subscribers, and uses American and Utica apparatus.

CALEDONIA, N. Y.—The Citizens' Telephone Company intends installing new apparatus. It has about 50 subscribers and is now spreading out in the direction of farmers' lines. Thirty-five new contracts are now on hand.

CAMERON, N. Y.—The Swale Telephone Company informs us through Mr. Downs that it has Stanley & Patterson and Mianus Electric apparatus. It has 20 subscribers. A change from the series to the bridging system is projected.

ROCHESTER, N. Y.—Mr. Stinson, general manager of the Rochester Telephone Company, informs us that a Stromberg-Carlson 4000-drop board is operated and another of 6400 capacity is projected. There are 4100 subscribers, and contracts come in at the rate of 10 each day.

STAFFORD, N. Y.—The manager of the Stafford Local Telephone Company, Mr. Pixley, notifies us of a projected extension of four or five miles, and expects a satisfactory increase of business. He operates Eureka apparatus, with a 6-drop board and 28 subscribers. The rate per message is only 5 cents.

CHESTERTOWN, N. Y.—Mr. C. H. Burge informs us that the apparatus used by the Chestertown Telephone Company is from the Western Telephone Construction Company. It operates a 100-drop board and has 75 subscribers. Recent growth has doubled the capacity, and future indications are equally good.

POTSDAM, N. Y.—The Racket River Telephone Company uses an American 200-drop board and has 215 subscribers. A full metallic circuit and 4000 feet of cable will be put in next Spring. It has connection with the St. Lawrence Telephone Company, which gives subscribers communication with several New York towns.

WELLSVILLE, N. Y.—We are informed by Mr. Savidge, of the Wellsville Telephone Company, that its apparatus was installed by the Century Telephone Construction Company—a 100-drop board and 75 subscribers. The company is now building, and uses cable system throughout. The 100-drop board is on the lamp signal system.

WEST EXETER, N. Y.—The Wharton Valley Mutual Telephone Company has apparatus of the Williams Electric Company. This line was built by $5 subscriptions by the people along the route. Those who helped have free use of telephones, of which there are now 23 in service. Those who have not helped pay 10 cents per message.

GRANVILLE, N. Y.—The Granville Telephone Company operates Eureka Electric apparatus, with a 400-drop board. It has 425 subscribers. Many increases are projected. This company has connections at Whitehall, N. Y., and Poultney, Vt., which covers a rich territory of the slate region of New York and Vermont, consequently the outlook is excellent.

NUNDA, N. Y.—We are indebted to Mr. G. W. Koppie, manager of the Business Mens' Telephone Company, for the undermentioned. The company covers about 70 miles of territory, and is a farmers' line, without any switchboard at present, and with about 100 instruments on the entire line. An 18-mile extension is contemplated.

MAYVILLE, N. Y.—Mr. Loomis, manager of the Mayville Telephone Company, sends us the following: With a Victor switchboard of any capacity under 200 drops it has 105 subscribers. Extensions have been made lately, and another to Jamestown is projected. Common return system is used in Mayville, and beyond full metallic party lines American Electric telephones.

ELYRIA, OHIO.—The North Ridgeville Telephone Company has increased its capital from $2,000 to $5,000.

EAST LIVERPOOL, OHIO.—The Columbiana County Telephone Company is building branch exchanges at Toronto and Cumberland.

ARLINGTON, OHIO.—The People's Telephone Company uses apparatus of the Harrison Electric Company, has a 100-drop board and 80 subscribers, with more in prospect.

FREMONT, OHIO.—The Fremont Home Telephone Company has established a new exchange at Lindsey. The business in that section of Sandusky County is growing rapidly.

COLUMBUS, OHIO.—The Central Union Telephone Company has added another section to its switchboard. The addition was made necessary through the great increase in business at this point.

WEST JEFFERSON, OHIO.—The West Jefferson Telephone Company, operating Stromberg-Carlson apparatus, has a 100-drop board and 56 subscribers. Party lines are to be built in the near future.

WEST MANSFIELD, OHIO.—The West Mansfield Telephone Company has American apparatus; a 100-drop board and 75 subscribers. A farmers' line is to be put in at once, and prospects are very good.

MARSHFIELD, OHIO.—The Marshfield Telephone Company uses apparatus of North Electric make, has a 50-drop board and 30 subscribers. Recent growth and prospects are very good, and a new line is projected.

LANCASTER, OHIO.—The Lancaster Telephone Company is installing an exchange at New Salem with lines connecting it with other villages in the county. The system in Fairfield is now in excellent working order.

RISING SUN, OHIO.—The manager of the Old Belt Telephone Company sends us the following: The company has a 100-drop board and 50 subscribers. New lines are projected to Hatton, Millgrove and Girton, all in Ohio.

TEMPERANCEVILLE, OHIO.—The Somerton Telephone Company operates a 12-drop board at Somerton, and a 6-drop at Temperanceville. Its apparatus is Western Construction Company's make, and it has 12 telephones on a toll line.

LEXINGTON, OHIO.—The Mansfield Telephone Company uses apparatus of the North Electric Company, a 50-drop switchboard, and has 66 subscribers. An exchange was put in last year, and the installation of some more telephones is projected.

NEW BREMEN, OHIO.—The New Bremen Telephone Company operates apparatus of the Sterling Electric Company, and has a 100-drop board supplying 84 subscribers, with three toll lines covering 30 miles. Prospects are good and an increase is in contemplation.

ROCKFORD, OHIO.—The Rockford Telephone Exchange Company has been in business about a year, and is progressing satisfactorily. Mr. Jackson informs us that it uses Sterling Electric apparatus. With a 200-drop board, it has 108 subscribers and an increase is projected.

BLUFFORDS, OHIO.—We learn from Mr. Frederick, of the Bluffords Telephone Company, that it operates a Eureka drop board of 300 capacity and has 315 subscribers, having added 100 telephones in the last year. Country lines have also been built and excellent service is given.

CALDWELL, OHIO.—The Caldwell Independent Telephone Company contemplates the addition of several small exchanges. It operates a 100-drop board, with 100 subscribers. Prospects are very good. Williams-Abbott, Williams Electric and American Electric apparatus are installed.

RICHWOOD, OHIO.—The secretary of the Richwood Telephone Company kindly sends us the following: They use Eureka and Stromberg-Carlson apparatus; a 200-drop board, and have 150 subscribers. Eighteen miles of farmers' lines are now being built, and prospects are very good.

GRANVILLE, OHIO.—Judge B. M. Critchfield, who has a franchise for an exchange in Utica, Ohio, expects to have it in working order by April. A complete system of farmers' lines will be run in every direction. All these will be connected with the Newark Independent Company's lines.

UTICA, OHIO.—The Utica Telephone Company has been granted a franchise in Utica. Farmers' lines will be run in all directions from the town, and it is expected that the exchange will start with 150 subscribers. Direct connection will be given with exchanges at Mt. Vernon, Newark and Columbus.

AMHERST, OHIO.—The Amherst Home Telephone Company, which has been in existence two years, has declared a 6 per cent dividend, besides laying aside a surplus. New officers have been elected as follows: H. G. Redington, president; Chas. Nichols, vice-president; Frank Steel, secretary-treasurer.

BATAVIA, OHIO.—The Batavia Citizens' Telephone Company has been granted a 25-year franchise to build an exchange at Williamsburg. The company has exchanges in all the towns surrounding Batavia and its field is rapidly enlarging. J. W. Gillfill is president and W. H. Baum, general manager.

ELYRIA, OHIO.—The Rawson Electric Company, manufacturers of telephones, is completing a brick building to connect with the one which it already occupies. The plant will be devoted entirely to the manufacture of telephone equipments and switchboards, the increase having been made necessary by the growth of the company's business.

COLUMBUS, OHIO.—The Ohio Telephone & Telegraph Company is stringing an aluminum circuit of seven strands of No. 14 wires between Columbus and Massillon. It is claimed this is the first aluminum circuit of this kind in this section of the country. From the Massillon exchange, direct connection will be made with Cleveland and Toledo. A new line has been built between Columbus and Delaware.

TOLEDO, OHIO.—The Toledo Home Telephone Company is offering unusual telephone service to the farmers of Lucas County. The service will be given at city rates and full metallic circuits are guaranteed; no party lines. The company is building lines throughout the district immediately surroundings the city, and the system is to be extended as soon as the exchange is placed in operation, which will be early next year.

XENIA, OHIO.—The Miami Telephone Company, which heretofore has operated the Bell system in Greene, Warren and Butler counties, has been succeeded by the Central Union Telephone Company. A number of improvements will be made. A new exchange will be built at Morrow; new boards will be installed at Middletown and Lebanon and new long-distance lines will be built to Wilmington, Washington, C. H., and Columbus.

NEW PHILADELPHIA, OHIO.—The Tuscarawas County Telephone Company informs us through its manager, Mr. Walter, that it operates American boards of 2200 drops, as follows: New Philadelphia, 600; Canal Dover, 400; Uhrichville, 400; Dennison, 300; Newcomerstown, 300, and Mineral City, 200. It has about 1725 subscribers. It is now extending lines to smaller towns. Independent companies all about are growing very rapidly.

AKRON, OHIO.—The strike of the linemen and electrical workers of the Central Union and People's Telephone companies, which has been on for more than two months, has been declared off, the men losing on every point. Few of the strikers will be taken back, since nearly all their places have been filled by non-union men. The strike has cost the Electrical Workers' Union $9,000, outside of the wages lost by the men, which runs high into the thousands.

SPRINGFIELD, OHIO.—Mayor Milligan has ordered the police to prevent the Springfield Home Telephone Company from working on Sunday. The company is pushing its underground work with all possible haste in order to complete it if possible before cold weather sets in. Citizens sympathize with the company and they want to see the streets in good order as soon as possible. The Springfield company is owned by Cleveland people and is independent of the Federal Telephone Company.

CHAGRIN FALLS, OHIO.—The village of Chagrin Falls has granted a franchise to the Cleveland Telephone Company which will enable it to place its wires underground or else in the alleys back of the main streets. The company

TELEPHONE NEWS.—(Continued.)

has been endeavoring for a number of years to secure a franchise in the village, and recently appealed to the Probate Court to force the grant. The independent company has also been granted permission to use the alleys if it desires, and it will probably change its lines in order to secure the preferred positions, with the hope of keeping the other company out.

COLUMBUS, OHIO.—The Columbus Citizens' Telephone Company, which is the best paying property in the system of the Federal Telephone Company, is securing new subscribers at the rate of 15 per day without having solicitors in the field. At present the Columbus Citizens' Company has 5600 telephones in use, after being in operation something over a year. The Central Union Company has had its exchange in operation for more than twenty years, and it is said it has less than 2000 lines in operation. The independent company will shortly make an additional installation of switchboards and cables in order to take care of new business.

CANTON, OHIO.—Messrs. J. B. Hoge, Maxime Reber, H. D. Critchfield and William Carey, officers of the Federal Telephone Company, held a meeting in Canton Nov. 24, and concluded a deal for the consolidation of the properties of the Massillon Telephone Company, with those of the Stark County Telephone Company, one of the subsidiary companies of the Federal. Heretofore the Massillon Company has controlled the lines in the western part of Stark County and the Stark County Company has controlled the balance of the county. The new Stark County Telephone Company has a capital stock of $500,000, and $350,000 in bonds are to be issued. The newly acquired property was formerly known as the Farmers Telephone Company, and it not only covers the field thoroughly in Massillon, but reaches Navarre, Canal Fulton, Dalton and other villages. The Stark County Telephone Company has already opened its exchange in Alliance, with 400 subscribers, and the main exchange at Canton will soon be opened for business. When the system is in full operation the toll lines will touch every hamlet and school district in the county and the subscribers will have long distance connection through the lines of the United States Telephone Company.

GUTHRIE, OKLA.—The Pioneer Telephone Company, capital stock $500,000, has been incorporated by J. M. Noble, E. E. Westevelt, David McKinstrey, of Perry; B. S. McGuire, of Guthrie, and others.

ELIZABETH, PA.—The Federal Telephone Company has been granted a franchise at Donora.

PITTSTON, PA.—A private telephone line is to be erected along the line of the Hazleton & Wilkesbarre trolley road.

ELIZABETHVILLE, PA.—The Lykens Telegraph & Telephone Company has lately rebuilt and extended its lines, replacing iron with copper wire. Mr. Buffington informs us that he operates a 50-drop board, and has 70 subscribers. Rates are $33 per annum.

PATTON, PA.—Mr. Denlinger informs us that the Huntingdon & Clearfield Telephone Company is now building its line from Ebensburg to Phillipsburg. It will then be extended to Tyrone, connecting east and west with other independent telephone companies.

ALBION, PA.—We learn from Mr. E. A. Collins, of the Albion Telephone Company, that it uses Stromberg-Carlson apparatus, with a 100-drop board and 75 subscribers, which will soon be increased to 100. The company stands ready to meet any demand for increased service.

LINESVILLE, PA.—The Linesville Telegraph & Telephone Company uses an American switchboard of 100 drops, and has besides Keystone and Stromberg-Carlson apparatus. There are 199 subscribers. Mr. Rushmore, the secretary, informs us that recent growth has been good.

ALLENTOWN, PA.—The Consolidated Telephone Companies of Pennsylvania formally organized in this city to-day. This company controls the independent telephone companies in the counties of Lackawanna, Luzerne, Carbon, part of Schuylkill, Lehigh, Monroe, Berks, Bucks, Montgomery and a long distance line connecting the same with New York and Philadelphia. The capital of the company is $4,000,000. Its present bonded debt is about $300,000. The following officers and directors were elected: R. E. Wright, of Allentown, president; Samuel E. Wayland, of Scranton, secretary and general manager; C. M. W. Keck, of Allentown, treasurer. The company is negotiating for the purchase of several additional plants.

CHARLESTON, S. C.—The Gordon Telephone Company will issue $75,000 of bonds and make improvements in its system.

ORANGEBURG, S. C.—Wm. C. Wolfe, W. H. Lukes and A. C. Andrews have incorporated the Orangeburg & St. Matthews Telephone Company.

CLARK'S HILL, S. D.—Mr. J. E. Luke operates the telephone in this place, and has only recently commenced operations.

SCOTLAND, S. D.—The People's Telephone Company, Mr. C. C. King, president, operates a switchboard of the Standard Telephone & Electric Company, of 120 drops, and has 65 subscribers. Recent growth has been good and prospects are better.

NASHVILLE, TENN.—The Dixie Telephone Company, of Grundy County, filed an amendment to its charter increasing its capital stock from $10,000 to $25,000.

SAN ANTONIO, TEX.—The Commercial Telephone Company is extending its field of operations to thirty-three counties of the State.

CARTHAGE, TEX.—The Oden Telephone Company uses Western Electric apparatus. It has a 100-drop board and 87 subscribers, with expectations of soon doubling the number.

ANDERSON, TEX.—The Anderson Telephone Company, which started with 15 miles of line, has grown to 80 within a year, and projects several more to give connection with all points in the county. Sterling apparatus is used; a 100-drop board, and the outlook could not be better.

RICHFIELD, UTAH.—A contract has been let to construct a telephone line from Parowan to Stateline.

SALT LAKE CITY, UTAH.—President G. Y. Wallace, of the Bell Telephone Company, states that the line to Beaver is completed, and that materials for the Milford and Frisco lines are being sent down as speedily as possible that there may be no delay in building those lines which it is intended shall be completed this winter. The line from Douglas, Wyo., north from Cheyenne is about completed, and Billings, Mont., will be connected up with the entire system as soon as the exchange now building can be made ready.

CORNWALL, VT.—The Cornwall Telephone Company has stations at several towns supplied from Western Electric switchboards at Cornwall, Whitney and Hubbartown. It has 132 subscribers, all within two years. A large increase is projected next Spring.

ADDISON, VT.—The Addison & Panton Telephone Company operates a 25-drop Western Telephone switchboard, and has 86 subscribers. Service commenced August 1, 1901, to cover the two towns and connect with others, and to put in 30 or 40 more telephones. Mr. F. E. Sears is president.

ENOSBURG FALLS, VT.—The Northern Telephone Company operates exchanges here, at Richford and at Swanton, with a 40-drop board in each place. It has 50 miles of toll line and 235 subscribers. The outlook is very bright; constant additions are being made. Mr. C. L. Ovitt is the manager.

PALMYRA, VA.—The Fluoanna Telephone & Telegraph Company operates Sumpter Telephone apparatus—a 5-drop board with 83 subscribers. It is now extending its lines to Richmond.

LOUISA, VA.—The Louisa Telephone Company has a 100-drop board in Louisa and Gortonville of Southern Bell Telephone & Telegraph Company's make. It has 140 subscribers and very favorable prospects.

EMPORIA, VA.—The Emporia Telephone Company operates a switchboard of 100-drop capacity and has 40 subscribers. Sumter Telephone & Electric Manufacturing Company's apparatus is installed. The outlook is promising.

TAZEWELL, VA.—We are indebted to Mr. C. C. Long, owner and manager of the Tazewell Telephone Exchange, for details of a thriving concern. His apparatus is Rawson Electric, and he has 165 subscribers, rapidly increasing. Thirty-six miles are now under construction, and the outlook could not be better.

WELLSBURG, W. VA.—The Wellsburg Telephone Company is prospering, and has connection with the United States Long Distance Company. Eureka apparatus is used; a 200-drop board, with 150 subscribers.

RIPLEY, W. VA.—The Ripley & Millwood Telephone Company, Ripley & Kenna Telephone Company, and Arbuckle & Ripley Telephone Company, each uses apparatus of American, Phœnix and Williams respectively. Various lines have been built and others are projected.

PIEDMONT, W. VA.—The Piedmont Telephone Company has installed apparatus of the Viaduct Manufacturing Company and uses a 15-drop board, another of 50 drops being projected. It has 40 lines, 10 to 40 miles long. New lines are to be constructed at once, probably of 600 miles. We are indebted to Mr. Brawner, general manager, for the above.

ABERDEEN, WASH.—A petition is in circulation asking the Sunset Telephone Company to build and operate a line between this city and Westport by way of Ocosta and Markham.

POYNETTE, WIS.—The Poynette Telephone Company has an American drop board of 100 capacity and 50 subscribers. Rates are $1 per month.

WONEWOC, WIS.—The Wonewoc & Hillsboro Telephone Company operates a 100-drop board and has Standard Madison apparatus. Business is brisk and prospects bright.

MILWAUKEE, WIS.—The Western General Telephone Company will probably be organized for the purpose of putting in a competing telephone exchange in Milwaukee.

ARCADIA, WIS.—The Arcadia Telephone Company has a 100-drop board and 75 subscribers. Twenty miles of toll line have been recently built. Stromberg-Carlson apparatus is installed.

OSSEO, WIS.—The Osseo Telephone Company operates three exchanges at Osseo, Eleva and Wondovi. Stromberg-Carlson apparatus is used, and there are 175 subscribers. The prospects are very good.

OAKFIELD, WIS.—The Oakfield Telephone Company, through Mr. N. E. Bristol, informs us that it uses Victor, Standard and American apparatus. Switchboard, 25 drops. There are 100 subscribers and a large increase is expected. Prospects are bright.

PLYMOUTH, WIS.—The Larson Telephone Company uses apparatus of the Chicago Telephone Supply Company, has 15 subscribers and 12 local stations. Recently a line has been added from Graham to St. Cloud touching intermediate towns, and further extensions are projected.

SHARON, WIS.—The secretary of the Sharon Telephone Company furnishes us with the following: It uses Sterling apparatus, has a 120-drop board and 89 subscribers. Increase has been rapid and the capital may be enlarged. Connection with the Badger State Long Distance and other lines renders the situation very favorable.

WEST SUPERIOR, WIS.—We are indebted to the manager of the People's Telephone Company for the following: Operating Stromberg-Carlson apparatus of 800-drop capacity, 900 equipped; it has 818 subscribers, a gain of 500 in less than two years. A toll line to St. Paul and La Crosse is contemplated. The outlook could not be better.

FONTENELLE, WYO.—The Opal & Big Piney Telephone Company informs us, through Mr. Holden, manager, that the line was constructed more for personal convenience than for public use. The apparatus used is Central Electric, and there are 22 subscribers.

Special Correspondence.

ENGLISH NOTES.

London Office Electrical World and Engineer, Nov. 22, 1901.

STEAM AND TROLLEY.—The directors of the London, Brighton & South Coast Railway Company have appointed Major Cardew and Mr. Philip Dawson as consulting electrical engineers, to advise generally on the subject of electric traction and in connection with electric works on their own line. The significance of this appointment lies in the fact that the Brighton & South Coast line has an exceedingly heavy suburban traffic out of London, and in the summer to seashore resorts. The directors apparently see possibilities of electricity being used on their suburban divisions, and, at all events, have taken a forward step in having the question systematically investigated.

SUBMARINE CABLE JUBILEE.—Due note is being made here of the laying of the first submarine cable. Naturally it was English. It crossed the Straits of Dover. A year before, on Aug. 28, 1850, a line twenty-seven miles long was sunk between Shakespeare's Cliff and Cape Grisnez, but the strand crossed a rocky ridge and snapped in two. Mr. John Watkins Brett, on behalf of his brother, Mr. Jacob Brett, the inventor and patentee, made this first experiment. The cable did really work. Congratulations were exchanged; stock messages were transmitted; but it was shortlived, hardly more than one clear day. The news was actually hidden away in small type in an obscure part of the newspapers. On the last day the *Times* woke up to the significance of the fact and said, on Aug. 31: "Instantaneous communication between England and France by electric agency may even while we write be actually taking place. It requires a shorter time for the transit of a message from London to the French coast than is necessary for tracing upon paper the shortest word in the English language." Next year a new cable was laid by the late T. R. Crampton, and it won immediate success. On Nov. 13, 1851, prices on the Paris Bourse were known in London within business hours, and England was once more united to the Continent. The second cable avoided Cape Grisnez, and was landed at Sangatte. At the end of the century there were beneath the seas and oceans of the world 1769 telegraph cables, having a total length of close on 189,000 nautical miles—enough to girdle the globe seven times, mostly English.

LARGE CONDUIT RAILWAY CONTRACT.—A few days ago the London County Council awarded to J. G. White & Company, of London, a contract for the sum of about £171,000, which covers the plate laying and road work for approximately 14 miles of track, all on the conduit system. This contract, however, does not cover the rails. A few days later the County Council awarded the contract for the complete generating plants for the above tramways to Messrs. Dick, Kerr & Company, of London, who will install apparatus manufactured by the English Electrical Manufacturing Company, of Preston, coupled to engines manufactured by Ferranti, Limited, of Hollinwood, Lancashire. The awarding of this contract to British companies has given universal satisfaction, as the whole of the generating plant will, therefore, be made by British companies, and as it embraces machines as large as 1500-kw capacity, it is certainly worthy of the sincerest congratulations to British manufacturers that they are now in a position to take care of such heavy work. These will be the largest machines which have ever been built in Great Britain, and being of three-phase character, it certainly speaks volumes for the progressive policy of the English Electrical Manufacturing Company that they are enabled to do such work so shortly after their organization. The bidders numbered two or three score, from England, America and the Continent. The contract covers electric plant for two generating stations, one for a direct-current temporary station, to be erected near Loughborough Junction, and a three-phase plant required for the permanent generating station, to be erected at Greenwich, together with the necessary sub-stations in connection with the electrification of the tramways above referred to. Dr. A. B. W. Kennedy, the Council's consulting electrical engineer, who has charge of this first section of the work of the County Council in reconstructing their tramways reported fully to the County Council on the tenders. For the supply of the continuous-current plant twenty-nine firms tendered, though with the alternatives which most of the companies proposed it made a total of 212 proposals. That of Messrs. Dick, Kerr & Company, for £25,964, was accepted. For the supply of three-phase plant, which, of course, is the more interesting of the propositions, twenty-two firms tendered, with alternate proposals, bringing the total number up to 160. Messrs. Dick, Kerr & Company also secured the contract for this plant, the price being £46,425, which was not by any means the lowest price. Messrs. Dick, Kerr & Company have undertaken to deliver the continuous-current plant in ten months, and the three-phase plant within eighteen months from the date of order, and this time in both cases is less than what was asked for when the tenders were advertised for. In addition to the main engines, Messrs. Dick, Kerr & Company will sublet to Belliss & Morcom, Ltd., of Birmingham, the manufacture of the auxiliary engines necessary.

General News.

ELECTRIC LIGHT AND POWER.

TOPEKA, ARIZ.—Topeka Federal Light, Heat & Power Company has been incorporated, with a capitalization of $1,500,000. The incorporators are Frank D. Lane, William English and C. V. Sayre, of Phœnix, Ariz.

SAVANNAH, GA.—Application has been made for a charter for the Savannah Electric Company. This is the organization that is expected to consolidate all the electrical interests of Savannah. The most prominent of the petitioners are George J. Baldwin, president of the Edison Electric Company; Capt. W. W. Mackall, president of the Savannah Union Station Company; Abram Minis, a local capitalist, and George Nagle, of Chicago. Considerable Boston capital is behind the organization. The capital stock of the new concern is $3,500,000, $1,000,000 to be preferred stock drawing 6 per cent. The common stock is to draw no interest until this dividend is paid. The franchise to be secured controls 23 miles of street and suburban railway and is a very valuable one. The capital stock of the Edison Electric Illuminating Company at present is $375,000, and it is bonded for $250,000. The Savannah Thunderbolt & Isle of Hope Railway is capitalized at $1,000,000, and it has $1,250,000 4 per cent bonds. The City & Suburban Railway is bonded for $250,000. The parties behind this consolidation movement have merged the electrical interests of Columbus, Ga.; Tampa, Fla., and Houston, Tex. Mr. Baldwin is president of the electrical companies in those three cities.

PANA, ILL.—A receiver has been appointed for the Pana Modern Electric Light Power & Street Railway Company.

WELLINGTON, KAN.—The town has voted to issue $15,000 electric light bonds.

DULUTH, MINN.—The Common Council has passed an ordinance to issue 4 per cent 30-year water and light plant extension gold bonds to the amount of $60,000, dated Jan. 1, 1902.

HELENA, MONT.—Mr. H. L. Walker has been appointed receiver for the Helena Power & Light Company.

MACON, MO.—The new electric light plant is completed and incandescent lights are now in use.

BEVIER, MO.—The city government is discussing a $10,000 bond issue for an electric light plant.

CHILLICOTHE, MO.—The proposition to issue bonds to the amount of $25,000 to build a municipal lighting plant was defeated at an election Nov. 26.

ST. LOUIS, MO.—The Citizens' Electric Lighting & Power Company has completed plans for a large electric light and power plant on its property at the foot of O'Fallon Street. All the contracts have been made and the work will be pushed forward rapidly. The completed plant will involve an outlay of $2,000,000.

NEW YORK, N. Y.—Commissioner Kearny, of the Department of Public Buildings, Lighting and Supplies, has arranged to open bids on Dec. 11 for furnishing, operating, and maintaining electric lamps for the term of one year from Jan. 1 next for lighting the streets, public buildings, and parks of the greater city; and for furnishing gas lamps on streets and in parks, etc., in all the five boroughs. The contract amounts in the aggregate to $2,879,041.23.

MARTIN'S FERRY, OHIO.—A proposition to issue $8,000 electric light bonds has been carried.

WARREN, OHIO.—An electrical plant for lighting and power is to be installed in the Warren rolling mill, including new engines, new automatic roll machinery, and a new yard crane engine.

BOWLING GREEN, OHIO.—George G. Metzger, of Toledo, has purchased a tract of land at Grand Rapids located along the river and including a dam in the river. From the headgate of the dam to the Detwiler power plant at Maumee there is a fall of 65 feet 5 inches, and it is estimated that this will develop 2500 horse-power. Mr. Detwiler recently secured permission from the State to build a pole line along the canal to Toledo, and it is stated that the parties will endeavor to secure a franchise for furnishing cheap light and power in Toledo.

SALT LAKE CITY, UTAH.—A large electric power plant is being developed near Tempe, Ariz., on the Arizona canal. Electric energy will be transmitted to Phoenix, 20 miles distant.

SALT LAKE CITY, UTAH.—The Twin Falls Land, Water & Power Company will build a 20,000-hp electric plant at Shoshone Falls, also an electric railway up the river about 30 miles.

SALT LAKE CITY, UTAH.—The Cobre Grande mine of La Cananea, Mexico, will put in a power plant for its smelters. There will be five generators, aggregating 350 kilowatts. Oil will be used as a fuel.

SALT LAKE CITY, UTAH.—The Telluride Power Company has completed its Logan extension south to North Salt Lake, while the Provo extension north has reached Bingham. The ends will be connected by Jan. 1.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—The City Council of Whittier, Calif., recently awarded to F. E. Newlin the franchise for an electric railway through the town.

SAN FRANCISCO, CALIF.—The Los Angeles & Redondo Railway Company recently made application to the City Trustees of Redondo, Calif., for a franchise for a double track electric line. The company is now operating a steam motor line. The motive power of the road will be changed to electricity and an improved service will be given between Los Angeles and Redondo.

ANDERSON, IND.—It is admitted that from 90 to 95 per cent. of the people are now patronizing the trolley line between this city and Muncie and between Muncie and Indianapolis. The parlor car limited service is popular and the service throughout is first class in every detail.

LOGANSPORT, IND.—The City Council has granted a franchise to the Wabash River Traction Company to enter the city in one of the most desirable streets in the city. This act is bound to precipitate litigation, as the local company claims exclusive rights to the streets of the city.

INDIANAPOLIS, IND.—Work on the extension of the Indianapolis & Greenfield Rapid Transit Company between Greenfield and Knightstown will begin at once, and it is expected to be completed early in January. This is the new property of the Indianapolis & Eastern Traction Company.

WABASH, IND.—An important deal was made here in the purchase of the old towpath between Lagro and Huntington by the Ft. Wayne & Southwestern Electric Railway Company. The consideration was $2,000 per mile. This deal removes the last obstacle to consummation of the plan of building a line to Logansport, thence to Lafayette.

INDIANAPOLIS, IND.—The Indianapolis & Eastern Traction Company has bought, and is now in control of the Indianapolis & Greenfield Interurban road. This company was incorporated last Spring to build a line to Richmond, and this line will form an important link. The company will extend the line to Richmond, Knightstown and Rushville at once.

INDIANAPOLIS, IND.—The managers of the interurban roads which refused to sign the franchise accepted by the Union Traction Company for admission to the city are still undecided. They have petitioned for an independent right of way into the city, but this is opposed by the local company. The Council is inclined to modify the terms of the franchise so as to base the compensation or tax on the length of the line.

BALTIMORE, MD.—R. Lancaster Williams, of Richmond, has been elected president of the recently purchased Knoxville Traction Company.

TRENTON, N. J.—The New Jersey & Pennsylvania Traction Company, with an authorized capitalization of $1,000,000 has been incorporated.

PATERSON, N. J.—There is a report that a new trolley line is about to be started here. The route of the company, according to reports, will traverse Bergen County, running from Hackensack down Market Street to Carroll, and down Sixteenth Avenue to the Susquehanna station on State Street. It is said the new organization is willing to pay the city a handsome sum for the privilege of establishing its proposed line. The incorporators are said to be Thomas McIntyre, a banker and broker of New York City; Preston Stevenson, of New York, and Frank Frost, a silk dealer of Paterson. The company is said to have a capital stock of $100,000.

ALBANY, N. Y.—The Massena & Raymondville Electric Railway Company has been incorporated; capital, $80,000. Directors: W. J. McKinney, H. H. Warren, and W. J. Patch, of Massena.

GLENS FALLS, N. Y.—The Hudson Valley Railway Company has given a mortgage of $4,000,000 to secure an issue of bonds, the proceeds of which will be used in retiring present bonds and completing extensions now in progress.

MT. VERNON, N. Y.—As outcome of the foreclosure sale of the franchises, etc., of the North Mount Vernon Railway Company, the Interurban Street Railway Company, of Mount Vernon, has incorporated with the Secretary of State; capital, $500,000. Directors: Andrew A. Halsey, Frederick C. Cocheu, Joseph F. Coffey and others, of Brooklyn.

MASON, OHIO.—The village of Mason has granted a franchise through town to the Rapid Railway Company of Cincinnati.

UPPER SANDUSKY, OHIO.—The Tiffin & Southern Railway has been granted a franchise for its line through Upper Sandusky.

UPPER SANDUSKY, OHIO.—Citizens of Upper Sandusky are promoting an electric railway to extend from this place to Bellevue.

SHELBY, OHIO.—Milney Roseborough, of Shelby, is securing right of way for an electric line from Mansfield to Norwalk by way of Greenwich.

COLUMBUS, OHIO.—The Columbus, London & Springfield Railway has ordered equipment for a second power-house, which will be located at London.

FINDLAY, OHIO.—The Toledo, Fostoria & Findlay Electric Railway Company has completed arrangements to carry United States mail between Fostoria and Findlay.

SPRINGFIELD, OHIO.—The Columbus, London & Springfield Railway is contemplating building two spur lines, one to South Charleston and the other to Mechanicsburg.

AUSTINTOWN, OHIO.—Citizens of Austintown are endeavoring to induce the Mahoning Valley Railway Company of Youngstown, to extend its Mineral Ridge line to Austintown.

COLUMBUS, OHIO.—The Columbus, Buckeye Lake & Newark Traction Company, which is building a line from Columbus to Newark, has increased its capital stock from $1,000,000 to $1,500,000.

AKRON, OHIO.—The Northern Ohio Traction Company is installing a large lighting generator in its Akron power house, and is endeavoring to secure a contract to illuminate the neighboring town of Barberton.

EATON, OHIO.—The Preble County Commissioners have granted a 25-year franchise to the Cincinnati, Hamilton, Richmond & Muncie Traction Company, which proposes to build a line from Cincinnati to Muncie, Ind.

CLEVELAND, OHIO.—The Richmond & Petersburg (Va.) Traction Company, which is composed of Cleveland people, has perfected traffic arrangements whereby its cars can enter both Petersburg and Richmond.

BOWLING GREEN, OHIO.—The Lake Erie, Bowling Green & Napoleon Railway has placed a contract for rails to be delivered as soon as possible. The road is under construction between Pemberville and Bowling Green.

COLUMBUS, OHIO.—The management of the Columbus, London & Springfield Railway has announced that the road will be ready for operation from Columbus to Springfield about Feb. 1. It will give through connection from Columbus to Cincinnati.

AKRON, OHIO.—The Akron City Council has granted a franchise to the Northern Ohio Traction Company for a new line on South Main Street to South Akron. The franchise ordinance was in the city's favor, and it is quite probable that the company will refuse to accept it.

COLUMBUS, OHIO.—It is reported in Columbus that the Pomeroy-Mandelbaum syndicate is quietly endeavoring to secure an option on the property of the Columbus Electric Light & Power Company. It is believed that this is a step in the direction of extending this line to Columbus.

NORWALK, OHIO.—The Norwalk, Greenwich & Mansfield Railway Company will shortly be organized. The leading promoters are M. J. Roseboro, of Canton, and J. C. Laser, of Norwalk. The road will touch Shenandoah, Rome, Greenwich and Olena. Work of surveying has been started.

FINDLAY, OHIO.—The southern division of the Toledo, Bowling Green & Southern Railway has been placed in operation from Findlay to North Baltimore, and a regular schedule has been instituted. The connecting link between the two sections of the road will probably be completed this winter.

MASSILLON, OHIO.—The Massillon Council has established a street railway route over streets desired to be used by the Northern Ohio Traction Company for its Akron-Massillon extension, and has advertised for bids for a road over the route. This ends a long fight between the company and citizens.

MANSFIELD, OHIO.—The Wellington, Savannah & Mansfield Railway Company has brought suit against the Mansfield Telephone Company, to restrain it from erecting a pole line along the highway from Mansfield to Ganges. The traction company claims to hold an exclusive franchise on the highway mentioned.

FOSTORIA, OHIO.—It is stated that bonds of the Ohio Northwestern Railway have been sold and that construction work will start as soon as possible with a view to placing the line in operation by the middle of next summer. The road will extend from Fostoria to Jerry City. W. D. Marks, of Fostoria, is at the head of the company.

SANDUSKY, OHIO.—The Erie County Commissioners have been asked to grant a franchise over several short stretches of road to the Sandusky, Clyde, Tiffin & Southern Railway. The road will be built largely on private right of way, all of which has been secured, and will extend from Sandusky to Tiffin. J. C. Parker, of Sandusky, is president of the company.

SANDUSKY, OHIO.—A shipment of rails has been received at Sandusky for the Sandusky, Bellevue, Monroeville & Norwalk Railway, a project which has been hanging fire for several years, after much grading had been completed. Contracts have been let for the equipment of the power-house which is partially completed. W. T. Forsyth is in charge of the construction work.

COLUMBUS, OHIO.—The Mt. Vernon, Mt. Gilead & Western Railway Company has been incorporated, with temporary capital stock of $10,000 by John W. Barry, U. G. Denman, C. D. Smiley, N. S. Wayne, Harry Gotz and Albert McVety, to build an electric railway from Mt. Vernon to Marion with a branch from Mt. Gilead to Galion and another from Mt. Gilead to Delaware.

MT. VERNON, OHIO.—A company, headed by J. W. O'Neil, of Topeka, Kan., and C. E. Jackson, of Middletown, Conn., is about to absorb the Mt. Vernon Electric Street Railway and the Mt. Vernon Electric Light & Power Company. The company expects to immediately begin the extension of new lines in Mt. Vernon and Knox County, one line going to Fredericktown and Gambier.

FREMONT, OHIO.—The Lake Shore Electric Railway Company has served notice on a number of parties along its line that electrical power now supplied them will be shut off in the near future. This includes the power furnished the Fremont Street Railway Company from the Fremont power-house. The company finds that the new lines shortly to be opened will tax the capacity of the Fremont station.

BRIDGEPORT, OHIO.—The Wheeling Traction Company, of Wheeling, has finally closed a deal for the control of the Steubenville, Mingoe & Ohio Valley Railway, which at present operates a line from Steubenville to Brilliant. The line will be connected with the line of the Steubenville & Wheeling Railway Company, which is the Wheeling Traction Company under another name, thus making a through line from Wheeling to Steubenville.

MARION, OHIO.—The Columbus, Marion, Tiffin & Toledo Railway has organized at Nevada, with C. W. Stoltz, Marion, president; W. L. Blair, Nevada, vice-president; G. A. Klaper, Sycamore, second vice-president; H. B. Hane, Marion, secretary, and C. E. Sawyer, Marion, treasurer. The road will run from Marion to Tiffin, connecting with lines now building to Toledo and Columbus. Of the 38 miles of right of way, 34 have been secured.

CLEVELAND, OHIO.—Recent stories relative to the sale of bonds by the Everett-Moore syndicate have been greatly exaggerated, according to a member of the syndicate who is in a position to know. The only bonds sold were $3,000,000 of Detroit & Toledo Shore Line and $2,000,000 of Lake Shore Electric. The report that a large block of Detroit United bonds have been sold is said to be ridiculous, since the Detroit United has no outstanding bonds, and the big Michigan consolidation has not yet been fully effected.

CLEVELAND, OHIO.—The Western Ohio Railway Company has been authorized by the Secretary of State to increase its capital stock from $1,000,000 to $3,000,000. The bond issue and mortgage will be increased to provide for extensions. The road is nearly completed from Lima to Minister. Eventually it will be extended south to Piqua and Sidney, where it will connect with the Southern Ohio Traction Company, and north to Toledo, thus making a through line from Cincinnati to Toledo. Work on the Lima-Findlay division has been started.

CLEVELAND, OHIO.—The officials of the Southern Ohio Traction Company have issued an announcement to the stockholders of the company, stating that the directors have in contemplation the consolidation of the property with several other electric railway properties. The properties to be consolidated are the Hamilton & Lindenwald Rapid Transit Company and the Miamisburg & Germantown Traction Company, both of which have recently been acquired by the Pomeroy-Mandelbaum syndicate. The former company has increased its capital from $100,000 to $250,000.

CLEVELAND, OHIO.—Representatives of a Cleveland syndicate composed of H. Clark Ford, L. W. Prior and W. V. Coons have bought up the La Salle-Peru (Ind.) Electric Railway. It is said that $100,000 was paid for the property. Recently the same people bought up the Streator Electric Railway for $160,000, and it is stated that negotiations are under way for the purchase of the Ottawa Street Railway, and that in event of the deal being closed, the syndicate proposes to construct an extensive system of interurban roads connecting Streator, Ottawa, Utica, La Salle, Peru, Spring Valley, Princeton and Ladd. About $2,000,000 will be spent by the syndicate in carrying out the project.

COLUMBUS, OHIO.—Secretary of State Laylin of Ohio, has just completed a report on electric railway incorporations. He states that for the year ending Nov. 1 there were 97 street and electric railway companies incorporated in Ohio, which was far more than any other class of corporations for profit excepting only the general class for manufacturing concerns. The total amount involved in these incorporations was $24,361,000, of which $16,361,000 was in the

form of increases of capital stock of such companies. Secretary Laylin recommends in his report to the governor that a law be enacted requiring corporations to make annual reports to his office giving such facts as may be considered proper and desirable for the State to know concerning them. He suggests also that before a corporation goes out of business, it ought to be required to file a certificate for reference purposes.

HOMESTEAD, PA.—The Homestead & Mifflin Street Railway Company will construct a line to Whittaker & Lincoln place. A $20,000 viaduct across Munhall Hollow will be constructed to reach Whittaker.

MILWAUKEE, WIS.—The Northwestern Electric Railway Company, capital $25,000, has been incorporated by C. A. A. McGee, H. F. Cochems and W. J. Scanlan, to build electric railway lines in Manitowoc and Sheboygan counties.

MILWAUKEE, WIS.—It is reported that a deal is on foot for the construction of an electric railway between Chicago and Milwuakee, apparently independent of all existing roads.

THE AUTOMOBILE.

THE INDIANAPOLIS TRANSFER COMPANY has expended $25,000 for ten automobile cabs and will put them in service at once. If the experiment proves successful others will be added.

THE GREENCASTLE AUTOMOBILE COMPANY, of Greencastle, Ind., capital $25,000, has been incorporated. The directors are Henry Remek, Q. Broadstreet, et al. The company will manufacture automobiles in Greencastle, Ind.

POSTAL AUTOMOBILES.—Several automobiles will be in the service of the St. Louis Post Office before next summer. The first one, it is thought, will be started some time in January or February, and will carry the mail between the Post Office and the branch station at the World's Fair grounds.

AUTOMOBILES ON THE EADS BRIDGE.—The Interstate Transit Company, which was recently organized under the laws of Illinois, with a capital stock of $200,000, will operate an electric automobile line across the Eads bridge at St. Louis, connecting with the street car lines of St. Louis and East St. Louis. The line is expected to be in operation by March 1, 1902. Six automobiles have been ordered from New York. Plans are being made for additional automobiles to carry twenty persons each.

EDUCATIONAL.

LEHIGH UNIVERSITY is erecting a stone laboratory, 90x43 feet, to be used in connection with the steam engineering work of the course in mechanical engineering. Next fall Lehigh will offer a new and extended course in electro-metallurgy—the first of its kind, it is believed, to be established in this country. The departments of civil engineering and of geology have recently received valuable gifts in the shape of surveying instruments, microscopes, and geological specimens for the microscopic study of rocks.

LEGAL.

DRILL GRINDER LITIGATION.—An important decision has just been rendered by Judge Wing in the Circuit Court for the Northern District of Ohio, sustaining the validity of two patents on drill grinding machines owned by the Worcester Polytechnic Institute, and under which the Washburn shops of the Institute are manufacturing. These patents cover important devices essential to the efficiency of drill grinding machinery and this decision is of great interest to manufacturers of this class of machinery and to the trade generally. A suit is now pending against other parties who have been manufacturing drill grinders.

BUCKET SHOP QUOTATIONS.—In an opinion handed down by the Appellate Court in Chicago, the refusal of the Board of Trade to furnish the Central Stock and Grain Exchange market quotations on the ground that it was conducting a bucket-shop business contrary to law, is upheld, and the decree granting a permanent injunction restraining the Board of Trade and the Western Union Telegraph Company from cutting or disconnecting the telegraph wires is reversed. The decision also reverses the decree of the lower court by which an order was issued restraining the Board of Trade from interfering with or prohibiting any person or firm becoming a member of the Board of Trade from doing business with the Central Stock and Grain Exchange the same as they do with other persons.

DELAYED TELEGRAMS.—A judgment secured by Dr. Edward A. Ayers against the Western Union Telegraph Company for damages for its failure to transmit promptly to the addressee a message delivered by him to its messenger, has been reversed by the Appellate Division of the New York Supreme Court. The telegram was sent from Monmouth Beach, N. J., to Far Rockaway. It was in reply to a message asking if he would perform an operation and requesting an immediate reply. Dr. Ayers, who is a specialist in obstetrics, sent a reply by the messenger. For a delay of over five hours in its transmission, whereby he lost a client, a jury gave the doctor a verdict for $200. Justice Ingraham, who gives the opinion of the appellate tribunal, says he does not think the testimony is sufficient to show negligence on the part of the company in the transmission of the message. In none of the cases to which the court's attention had been called had it been held "that the delay of about five hours in the transmission of a telegram from an office located in a country district in one State, to an office located in a country district in another State, especially on Sunday, when telegraph offices, as well as the offices of other persons and corporations engaged in the transaction of business are necessarily closed for a portion of the day, has been of itself held to be evidence of gross negligence." The court also holds that the regulation upon the back of the telegram by which the sender agreed that the messenger to whom he delivered the answer at Monmouth Beach should be considered as his agent, and not the agent of the company, in delivering the message to the company's operator, was, under the circumstances of the case, a reasonable regulation for the transaction of the company's business. "If the plaintiff had wished to insure the immediate transmission of his message he could have taken it himself to the transmitting office; but with knowledge of this regulation, which he agreed to, if he trusted the message to the messenger who had delivered a telegram, the company would not be responsible for its transmission until it was actually received at the transmitting office."

OBITUARY.

MR. A. W. SOPER.—We regret to state that Mr. Arthur W. Soper died at his home in New York this week, after a five days' illness of acute stomach trouble. He was born in Rome, N. Y., on July 16, 1838. Previous to 1889 he was a railroad man, beginning on the Rome, Watertown & Ogdensburg Railroad, and finally becoming general manager of the St. Louis, Iron Mountain & Southern Railroad. After ten years of service for the latter company he came to New York and became engaged in various interests incidental to railway enterprise. He was president of the Safety Car Heating & Lighting Company and of the Pintsch Compressing Company, and a director in the American Mutoscope Company, Sackett Wall-Board Company, Standard Coupler Company, Citizens' Insurance Company of New York, and the Wheeling & Lake Erie Railroad. Outside of business he was a member of the Union League, Lawyers', Engineers', City, Lotus, and New York Athletic Clubs, the Republican Club of the City of New York, the Sons of the American Revolution, the Museums of Art and Natural History, and of the Chamber of Commerce.

PERSONAL.

PROF. GEORGE FORBES has recently brought before the English public a new "one-man portable-base range-finder" which is said to be very accurate up to 3000 yards, for infantry.

DR. F. A. C. PERRINE has returned to Pittsfield from his long visit to the Pacific Coast. He has brought back incidentally a contract for Stanley power apparatus, running, it is said, up to about $150,000.

MR. E. J. BERG, of the electrical engineering department of the General Electric Company at Schenectady, has been visiting Europe and was last heard of at the Berlin factories of the Union Elektricitäts Gesellschaft.

MR. JACOB A. CANTOR, the president-elect of the Borough of Manhattan, is devoting his thought and energies to the question of streets signs, discussed of late in these columns. "Reform" in this respect is, indeed, badly needed.

MR. PHILIP DAWSON, (M. I. Mech. E., M.I.E.E., Asso. M. Inst. C.E.), of London, has severed his connection with Robert W. Blackwell & Company, Limited, and will practice as a consulting engineer at Lennox House, Norfolk Street, London.

MR. PAUL M. KRAHMER, formerly of the Stromberg-Carlson Telephone Manufacturing Company, is now in charge of the Continental Construction Company, Marquette Building, Chicago, which will do a general financing and construction business.

MR. E. H. JOHNSON, the well known electrical engineer, inventor and promoter, is now in this country, and is making his business headquarters at the Quintard Iron Works, East River, New York City. He is engaged on some developments of considerable importance.

DR. N. S. KEITH has recently been employed on some mining expert work for the New Jersey Copper Mining Company, which is to begin work on the Menlo Park deposits which were worked by Indians nearly two centuries ago, and will now have an output of 80 tons of ore a week.

PROF. SIDNEY H. SHORT, accompanied by Mrs. Short, sailed for England this week on the Kronprinz Wilhelm, after quite a long stay, during which he visited several points of interest. He also participated in the recent American Street Railway Convention and attended the recent meeting of the American Institute of Electrical Engineers.

DR. JOSEPH B. DE LERY, who was once well known in the electrical field, has brought suit against Henry H. Rogers, a large stockholder in the Standard Oil Company, and other industrial combinations, for $100,000 damages, to recover possession of the patents upon which the De Lery Light Company is founded. The light is not electric, however.

MR. F. BOELLING, chief engineer of the Prometheus Company, Frankfort-on-the-Main, Germany, sailed for Germany on Monday last after a very successful visit in this country for the purpose of introducing in the American market the electrical heating apparatus manufactured by his company. The apparatus is already coming into very extensive use in Europe.

PROF. R. O. HEINRICH, whose presence in this country was noted recently, found it possible to prolong his stay and enjoy a few more days here than seemed possible. He sailed for Germany on Saturday last by the Waldersee, having made a very enjoyable stay and renewed many old friendships with former American associates. Prof. Heinrich is the European representative of Mr. Edward Weston and the Weston instruments.

DR. R. T. GLAZEBROOK.—It will be remembered that Congress last winter made liberal appropriations for the establishment of a Bureau of Standards at Washington. The National Physical Laboratory of Great Britain was established two years ago, and being thus further advanced than our own serves somewhat as a model. An article by its director, Dr. R. T. Glazebrook, in the last number of *The Popular Science Monthly* is thus of interest at the present time. The author gives full and ample illustrated descriptions of the Laboratory in Bushy Park and of the objects of a national physical laboratory.

Trade Notes.

FIRE.—The factory at New Bedford, Mass., of C. S. Knowles, dealer in electrical supplies, Boston, Mass., was destroyed by fire recently.

INCREASE OF CAPITAL.—The Green Fuel Economixer Company, of Matteawan, N. Y., has increased its capital stock from $50,000 to $200,000.

THE OSBURN FLEXIBLE CONDUIT COMPANY, 21 Park Row, New York, reports the success of "Flexduct" to have been instantaneous, and orders are coming in from all quarters, which is most gratifying to this concern.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is calling attention to its I. X. L. weatherproof, slow-burning, and slow-burning weather-proof wire. Prospective buyers of this high-grade wire would do well to obtain prices and further information from the Central Electric Company.

FUSELESS ROSETTES.—A leaflet recently issued by the New England Electric Manufacturing Company, 71 Federal Street, Boston, Mass., contains a pointer as to the advantages of the fuseless rosettes of this company. On a loose sheet is an illustration of one of these rosettes, showing how the device is wired.

THE ELECTRIC APPLIANCE COMPANY, Chicago, sales agent for Gutmann wattmeters, manufactured by the Sangamo Electric Company, is jubilant over the fact that although the factory was doubled within the past six months, the orders it is sending in are forcing the company to again double its facilities. The Gutmann meter has "caught on."

GEARING.—A 48-page pamphlet just issued by the Dayton Globe Iron Works Company, Dayton, Ohio, contains a complete list of the company's bevel and spur mortise gears, iron spur gears and iron bevel gears. In the manufacture of these gears the Dayton Company uses a grade of charcoal iron which is especially adapted to insure great strength and durability.

MR. E. C. MULCEY, electrical contractor, has opened an office at Oak Lane, above Eighth Street, Philadelphia, Pa. Mr. Mulcey will make a specialty of furnishing annunciators, burglar alarms, call bells, electric lighters, electric fans, etc. He will also do all kinds of electric wiring and repairing. Mr. Mulcey has the best wishes of the electric fraternity in his new enterprise.

THE INDUCTOR TYPE OF GENERATOR, a technical treatise by Edward Heitmann, which ran as a serial in ELECTRICAL WORLD AND ENGINEER of Oct. 5, 12 and 19, has been reprinted with illustrations in pamphlet form, making bulletin No. 123 of the S. K. C. system. Copies may be had by addressing the Stanley Electric Manufacturing Company, Pittsfield, Mass.

THE C & C ELECTRIC COMPANY, of New York, has appointed as its Pacific Coast agent the old and well known machinery firm of Parke & Lacy Company, located at San Francisco. The Parke & Lacy Company is to be very soon succeeded by Harron, Rickard & McCone, a corporation recently organized to take over the old company and extend the scope of its work.

THE HAINES & NOYES COMPANY, of Chicago, is sending out a most attractive advertising card consisting of a large black owl on a red and yellow background. When the tail of this owl is pulled, it will be found that attached to it is some printed matter and the "platform" of the Haines & Noyes Company. This "platform" or "policy" is short and to the point, but it seems excellent in every way.

CABLE CLIP.—The uses and advantages of the Boston cable clip, manufactured by the Chase-Shawmut Company, 390 Atlantic Avenue, Boston, Mass., are described in a pamphlet just issued by that company. The device is clearly illustrated, the cuts showing progressively the method of fastening the clip. This clip has real merit and should be looked into by those interested but unfamiliar with the device.

INCREASE OF CAPITAL.—The Marshall-Sanders Company has increased its capital from $50,000 to $100,000, to take care of its rapidly increasing business. The company is located at 301 Congress Street, Boston, with branch offices in New York and Chicago. It is manufacturer of electrical specialties, including sockets, switches, cut-outs, etc. Mr. Norman Marshall is president, Mr. Charles A. Sanders, secretary and treasurer.

"A SIGN OF THE TIMES."—This is the suggestive title of a pamphlet issued by the Mason Monogram Company, 11 Broadway, New York, which manufactures automatically changeable electric display and advertising signs. Attention is called to the possibilities offered by this sign in the way of announcements, advertising, etc. The Mason sign was very fully described and illustrated in ELECTRICAL WORLD AND ENGINEER, March 2 last.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, reports that the demand for line and construction material has been heavier this fall than at any previous time in its business. It is prepared to ship promptly any of the many appliances necessary to fix up lines for the heavy winter strain on them. The company issues a very complete catalogue covering these, representative of one of the very largest stocks in the United States.

STANLEY & PATTERSON, 93 Liberty Street, New York City, the well known electrical supply manufacturers, have in press a 112-page catalogue, entirely devoted to their large line of telephone apparatus and supplies. In this interesting book are illustrated no fewer than 100 different types of telephones in addition to a full line of telephone apparatus. Copies of the catalogue should be applied for immediately.

NEW ENGLAND ELECTRICAL MANUFACTURING COMPANY suffered by a fire which visited on Nov. 20 the large building at Somerville, Mass., near the Arlington branch of the Boston & Maine Railroad. The fire appears to have originated in the explosion of a fresh barrel of lacquer. Damage to the extent of about $20,000 was done, covered by insurance. Mr. Guy H. Proctor, manager, reports immediate resumption. The company is employing 125 hands, and can fill immediate orders.

ELECTRIC FLASHER.—If electricians and electric light men were more familiar with the workingF of the Reynolds Electric Flasher, manufactured by the Reynolds Electric Company, 221 Fifth Avenue, Chicago, they would be in a position to increase the number of electric signs in their territory by reducing the cost of maintaining them, and increase their effectiveness. Some merchants do not use electric signs because they cost so much. The Reynolds Flasher appeals to such because it keeps the light turned off half the time and saves half the current. Descriptive matter can be had upon application.

ELECTRIC FLASHLIGHT.—The advantages of the hand electric flashlight are becoming so well known that the manufacturers find them one of their best selling articles. Mr. Wm. Roche, 42 Vesey Street, New York, makes a flashlight that has very meritorious features. In the first place it is light, weighing only 1 lb.; it is compact, measuring 9½ inches over all by 1⅝ inches diameter; it is always ready for work; it is portable, and it is safe. On account of the latter feature it can be used around gas and gasolene engines, launches and automobiles without danger of causing explosion, and on account of its lightness it can be used as a bicycle light in an emergency. These lights are supplied with Mr. Roche's new standard dry cells, which have long life.

REFERENCE LIBRARY FOR MECHANICS.—For the purpose of showing the scope and high standard of the American School of Correspondence, the trustees have voted to apportion a limited number of sets of their special holiday edition of the "Reference Library of Engineering Practice" to given districts to be awarded to properly recommended students enrolling for full engineering courses during the month of December. This Library consists of the most important instruction papers in its electrical, stationary, locomotive, marine and mechanical engineering courses. It is in five quarto volumes, handsomely bound in half morocco, and contains 2842 pages, and 1975 illustrations, consisting of original drawings, sketches, sections, details, etc., illustrating every detail of the subjects treated, is thoroughly indexed, and is a unique and extremely valuable addition to every progressive man's library. The library is printed solely for students of the American School, and, as the edition is limited, it would be well to apply at once, as applications can be considered only in the order received. A handsome large handbook describing methods of instruction and the library in detail will be sent to any one upon application.

AMERICAN ELECTRIC TELEPHONE COMPANY.—Among the larger and more prominent manufacturers of telephones and exchange equipment, the American Electric Telephone Company, Chicago, has been quite successful in designing and developing a high class of modern telephone apparatus. Its latest type of central energy multiple switchboard contains approved features of electrical and mechanical construction necessary to the rapid service required from a modern plant. The product of the company comprises everything necessary for the construction and operation of a complete telephone equipment, from the small village exchange to the large metropolitan plant. Among the large number of exchanges recently installed or under contract by this company may be mentioned the new 1200-line central energy equipment at Xenia, Ohio, and Reading, Pa.; 4800-line central energy plant, Philadelphia, Pa.; 8000 telephones, 10,000 terminals, Mansfield, Ohio; 2500 central energy exchange, Marion, Ind.; 1200-line exchange, central energy, Harrisburg, Pa.; 3000-line capacity central energy, Trenton, N. J.; 4800-line exchange, Zanesville, Ohio; installing for 3000 ultimate capacity central energy, Austin, Tex.; 3000-line central energy exchange, Oklahoma City, I. T.; central energy equipment, serving 1200 subscribers, Huntington, Ind.; 1000 central energy, El Paso, Tex., and a number of smaller exchanges, ranging from 500 to 10,000-line capacity.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED NOV. 26, 1901.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, Times Bldg., New York.]

687,189. SYSTEM OF MOTOR CONTROL; W. S. Andrews, Schenectady, N. Y. App. filed July 25, 1901. (See Current News and Notes.)

687,195. SYSTEM OF TRAIN CONTROL; F. E. Case, Schenectady, N. Y. App. filed April 24, 1901. (See Current News and Notes.)

687,203. OVERFLOW ALARM FOR REFRIGERATORS; H. L. Cripps, Jersey City, N. J. App. filed July 9, 1901. A float is pivoted to the bottom of the refrigerator in such a position as to rest upon the surface of the water in the drip pan, and close an alarm circuit when the pan becomes full.

687,222. SYSTEM OF MOTOR CONTROL; A. S. Garfield and C. E. D'Ornellas, Paris, France. App. filed July 27, 1901. (See Current News and Notes.)

687,230. INSULATOR SUPPORT; T. E. Hallett, Chicago, Ill. App. filed Sept. 7, 1901. The threaded end of the pin is formed of sheet metal having the thread rolled in it and made in sections to be slightly yielding for difference in sizes.

687,234. RESOPHONE FOR TELEGRAPH INSTRUMENTS; F. W. Inden, Duluth, Minn. App. filed Jan. 26, 1901. The sounder is inclosed in a sound-proof box from which the sound reaches the ear of the operator through a trumpet.

687,261. MOTOR CONTROL SYSTEM; W. B. Potter, Schenectady, N. Y. App. filed June 15, 1901. (See Current News and Notes.)

687,297. ELECTRIC RELEASING APPARATUS FOR PNEUMATIC PRESSURE BRAKES; A. Bruggemann, Breslau, Germany. App. filed Aug. 2, 1900. The circuit of an electrically operated valve is closed by a manometer, when the pressure in the train pipe falls below the working pressure to thereby set the brakes and call attention to the condition of the system.

687,324. GUN SIGHTING APPARATUS; Edw. W. Lloyd, Newcastle-upon-Tyne, Eng. App. filed April 9, 1901. A miniature target is placed a short distance in front of the gun, the target being capable of movement in any

direction by hand; a diagram holder moves with the target and is marked at the moment the electric circuit of the gun-firing mechanism is closed, by a pencil affixed to the gun.

687,386. PROCESS OF EXTRACTING SUGAR; B. Schwerin, Munich, Germany. App. filed May 25, 1901. (See Current News and Notes.)

687,389. COVERING FOR SUBTERRANEAN CABLES; O. Wilhelmi, Dusseldorf, Germany. App. filed June 20, 1901. A cable provided with a covering composed of bags containing beton.

687,422. ELECTRICAL SWITCH; W. C. Calkins, Momence, Ill. App. filed Feb. 23, 1901. A switch comprising a number of pairs of pivoted arms and contact points of U-shape, with their open ends presented towards the arms.

687,440. WIRELESS TELEGRAPHY; H. Shoemaker, Philadelphia, Pa. App. filed June 10, 1901. A system having means for causing an increased difference of potential between the plugs of the coherer in order to increase the coherence.

687,452. TROLLEY; G. E. Chapman and G. L. Ensign, Cleveland, Ohio. App. filed Feb. 20, 1901. Means for feeding oil continuously from oil chambers to the bearing and at the same time maintaining the bearings dustproof.

687,455. STATIC ELECTRIC GENERATOR; L. Frandsen and L. Holzhauer, Sandusky, Ohio. App. filed Sept. 20, 1901. The capacity of the machine is said to be increased by arranging the sectors on two glass disks in two concentric rows which slightly overlap each other, the upper portion of the inner row and the lower portion of the outer row, being arranged for contact with the neutralizing brushes.

687,457. ELECTRODE; L. Hargreaves and W. Stubbs, Farnworth-in-Widnes, Eng. App. filed April 9, 1901. (See Current News and Notes.)

687,473. ELECTRIC ARC LAMP; L. F. Bogia, Jr., Philadelphia, Pa. App. filed Dec. 31, 1900. Details.

687,479. ELECTRIC WINDING CLOCK; W. H. Hall, Chicago, Ill. App. filed March 15, 1901. The circuit of an electric winding motor is closed, at intervals, by the clock.

687,569. RHEOSTAT; J. Lundie, New York, N. Y. App. filed Aug. 15, 1901. The resistance is composed of units cast or formed into circular spirals connected in pairs together in S form. These units have a perforated hub at the center of the spiral whereby they are threaded on tie rods; insulating and conducting washers placed alternately between the hubs of adjacent units connect the various spiral resistances in series.

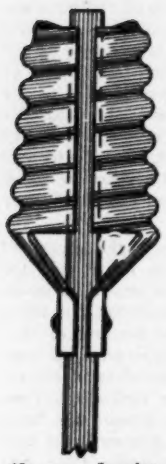
687,576. ELECTRICAL PROTECTOR; Charles A. Rolfe, Chicago, Ill. App. filed Dec. 1, 1899. (See page 944.)

687,579. MAGNETIC SEPARATOR; F. A. M. Schiechel, Frankfort-on-the-Main, Germany. App. filed April 26, 1898. In a magnetic separator, a magnet having a pole-piece arranged edgewise in a substantially vertical plane and means for projecting the material to be treated in a generally horizontal path or trajectory across the plane of said pole-piece, whereby the influence of the magnet shortens the trajectory of the paramagnetic particles and causes them to fall on the near side of said magnet while the remaining constituents of the mass are carried on and fall on the opposite side.

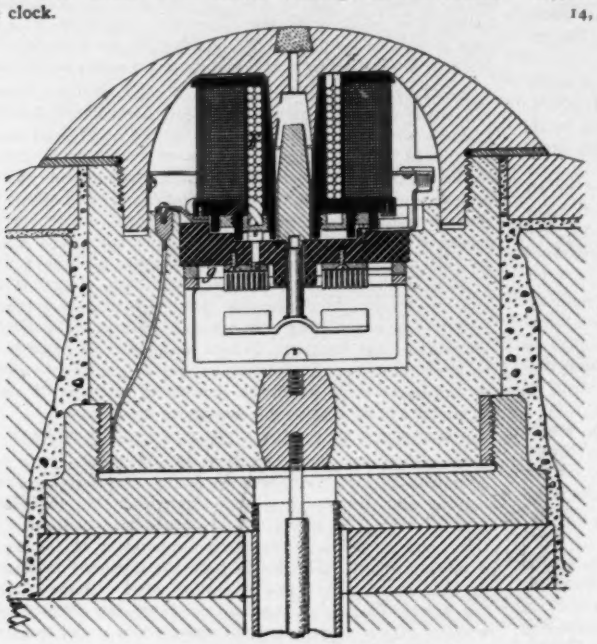
687,615. ELECTROMAGNETIC APPLIANCE; A. Duppler, Jersey City, N. J. App. filed March 25, 1901. A series of magnets and their armatures arranged at increasing distances from their corresponding magnets, means whereby the efforts exerted between such magnets and their armatures may be applied to a body to be moved, and means whereby as such body is moved under the influence of the attraction of such magnets for their armatures, such body is held in the position to which it has at any time been drawn by the effort tending to maintain the nearly closed magnetic circuit between the armature and its corresponding magnet last to come in contact.

687,617. MOUTH ILLUMINATOR; E. Ebi, Cedar Rapids, Ia. App. filed Feb. 1, 1901. A small casing adapted to inclose a lamp and having a tube extending from it, through which the rays are reflected against mirrors at the outer end of the tube.

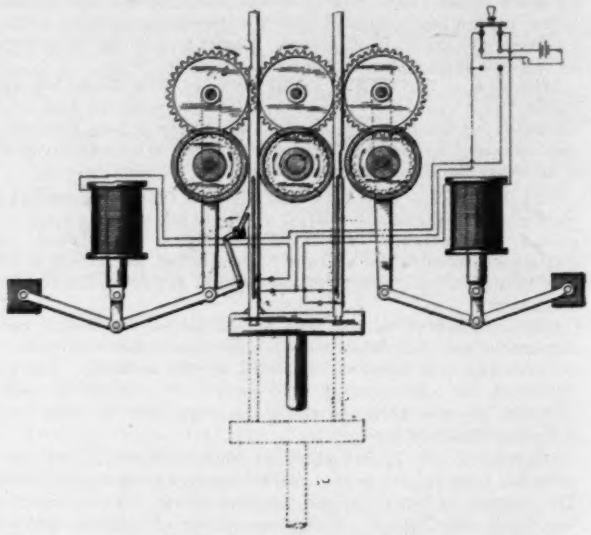
687,622. RAILWAY BRAKE; A. Green, Rochester, N. Y. App. filed May 14, 1901. A single handle applies the mechanical and the electric brake, means being provided for varying the amount of braking effort applied by the mechanical brake before cutting in the electric brake.



687,230.—Insulator Support.



687,522.—Electric Railway.



687,690.—Electro-mechanical Actuating Device for Electric Switches, Valves, etc.

687,499. TELEPHONE TRANSMITTER; William W. Dean, Chicago, Ill. App. filed March 22, 1901. (See page 944.)

687,505. ELECTRIC FURNACE; M. Ruthenburg, Philadelphia, Pa. App. filed Feb. 19, 1901. (See Current News and Notes.)

687,517. INSULATED ELECTRIC CONDUCTOR AND PROCESS OF MAKING SAME; W. S. Clark & G. H. Rupley, Schenectady, N. Y. App. filed Dec. 15, 1899. The conductor is coated with a closely adherent, non-brittle, homogeneous covering containing or composed of amorphous cellulose.

687,518. APPARATUS FOR COATING WIRE OR ELECTRIC CONDUCTORS; W. S. Clark and G. H. Rupley, Schenectady, N. Y. App. filed Dec. 15, 1899. Machine for coating the conductor previously described.

687,522. ELECTRIC RAILWAY; F. C. Esmond, New York, N. Y. App. filed Feb. 21, 1898. Switching apparatus intended to make sure the operation of supplying and cutting off current to and from the working buttons.

687,531. INSULATING MATERIAL; Chas. W. Jefferson, Schenectady, N. Y. App. filed Feb. 7, 1901. Alternate layers of mica scales and a pliable adhesive insulating substance are built up into a sheet; the latter substance is applied when in a liquid or plastic state, and consists of linseed oil dissolved in benzine, to which a very small portion of some gum such as copal is added. A light pressure is applied to the sheet so formed sufficient to smooth out the layers and to expel the benzine gas, after which the sheet is dried by the application of steam heat.

687,532. METHOD OF MAKING INSULATING MATERIAL; Chas. W. Jefferson, Schenectady, N. Y. App. filed Feb. 7, 1901. Method of carrying out above process.

687,561. TROLLEY MOUNTING; F. C. Greene, Lynn, Mass. App. filed March 21, 1901. Details.

687,623. ELECTRIC TRANSMISSION OF POWER; J. B. Hall, Chicago, Ill. App. filed Feb. 4, 1901. A detail of a peculiar type of electrical generator, called a variarotor, which is described as a torque-producing or accelerating, or variable-speed mechanism which provides a means of obtaining a useful pull with a minimum expenditure of energy. The detail consists of an inductive resistance in circuit with the armature winding.

687,669. ELECTRICAL SNAP SWITCH; G. B. Thomas, Hartford, Conn. App. filed Sept. 3, 1901. Details.

687,681. ELECTRICAL APPARATUS; Merritt Gally, Brooklyn, N. Y. App. filed Sept. 9, 1901. (See page 944.)

687,682. TELEPHONIC APPARATUS; Merritt Gally, Brooklyn, N. Y. App. filed Sept. 16, 1901. (See page 944.)

687,690. ELECTROMECHANICAL ACTUATING DEVICE FOR ELECTRIC SWITCHES, VALVES, ETC.; E. N. Lake, Chicago, Ill. App. filed June 20, 1901. The device comprises a plurality of parallel rollers geared together, a frame embracing a bar adapted to pass between two of said rollers, one of said two rollers being fixed and the other being bodily movable forward and away from the bar in a manner to pinch the bar between the movable and stationary rollers, the adjacent faces of said rollers moving in the same direction and electrically actuating means for forcing said movable roller against the bar.

687,695. ELECTRIC LAMP; K. Ochs, Berlin, Germany. App. filed March 21, 1899. (See Current News and Notes.)

11,952. WIRELESS TELEGRAPH SYSTEM; H. Shoemaker, Philadelphia, Pa. App. filed April 9, 1901. The coherer tube is rotated after each impulse, to separate the particles.